FINAL CORRECTIVE MEASURE DESIGN

Prepared For:

REFINED METALS CORPORATION
Beech Grove, Indiana

Prepared By:

ADVANCED GEOSERVICES
West Chester, Pennsylvania

Project No. 2003-1046-18
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TO BE SIGNED AND SEALED AT TIME FINAL DESIGN IS TO BE APPROVED. NOT FOR CONSTRUCTION UNTIL SIGNED AND SEALED

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GENERAL TERMS AND DEFENITIONS

Cap Soil Fill – Material utilized as the 18 inch soil layer between the geocomposite drainage layer and topsoil on the Containment Cell cap. Cap Soil Fill shall meet the requirements established in Specification Section 02210, Part 2.3.

Construction Schedule – Document prepared prior to mobilization and updated every other week during execution of the Contract, presenting the planned and logical sequence of work, including key milestones, critical path elements and duration of work. (See Specification Section 01050).

Construction Quality Assurance Plan (CQAP) – Provided as Attachment D to the CMD. Describes the general QA procedures and requirements to be implemented by the QA Representative during CM implementation.

Containment Cell – Proposed on-site area designated for the placement of remediated soils and sediment and specified debris. The containment cell will be constructed by cutting and filling to create berms as shown on Sheet 5. After waste placement the cell will be covered with a composite cap to prevent infiltration of surface water and direct contact by potential receptors.

Contaminant Reduction Zone (CRZ) – Temporary location established for the purpose of removing potentially contaminated soil, sediment and/or debris from vehicles, equipment and personnel moving from a remediation area to a clean or previously remediated area.

Contractor – Entity retained by RMC for the purpose of implementing the CMD. Contractor shall be experienced in environmental remediation of a similar type and nature and will retain subcontractor's to provide specialty services as appropriate.

Corrective Measures Design (CMD) – Comprehensive document (design report, specifications, calculations, construction quality assurance plan, design drawings and inspection and maintenance plan) prepared by Advanced GeoServices Corporation on behalf of RMC to present the technical requirements for remediating and restoring the RMC Beech Grove site and adjacent off-site areas to satisfy the requirements of the Consent Decree between the USEPA, IDEM and RMC.

Daily Report – Written report prepared by the Contractor detailing work completed, technical discussions/decisions, health and safety issues, analytical results, weather conditions, air monitoring results, material delivered to the site, and other information relevant to completion of the project. Daily Reports for each work day shall be submitted to the QA Representative by noon the following work day.

Drainage Ditch Aggregate – AASHTO #1 coarse aggregate imported from a quarry used for restoration of drainage ditches. See Specification Section 02936, Part 2.8.1.

Engineer – The Advanced GeoServices Corp. Project Manager, licensed as a Professional Engineer in Indiana and responsible for preparation of the CMD.

Former Manufacturing Area – General term utilized in CMD intended to include various terminologies used during the RFI, the BHHRA, CMS, and various correspondence to describe that portion of the RMC owned property predominantly covered by buildings, pavement and miscellaneous structures (including "facility area", "on-site area", "on-site main facility area", and "former manufacturing area"). This area is separate and apart from the portion of the RMC owned property predominantly covered by woods, brush and lawn generally referred to as the "grassy site area".

General Site Fill – Material generated by cutting during grading activities performed after completion of required remediation (excluding topsoil) and utilized for filling areas no deeper than 2 feet below the proposed ground surface. General Site Fills are not subject to compaction testing but shall be visually stable after placement and compaction. General Site Fill may be utilized as Structural Soil Fill when geotechnical properties are approved by the QA Representative.

Granular Fill – Material utilized for filling beneath the water table and as on-site surface stone aggregate. See Specification Section 02210, Part 2.4.

Hazardous Waste Management Unit (HWMU) – Interim status RCRA units subject to Closure under IDEM. HWMUs include the surface impoundment, outdoor waste piles and the indoor waste piles.

Health and Safety Officer – Employee of Contractor experienced in remediation and construction, meeting the requirements and performing the duties described in Specifications Section 01351.

Health and Safety Plan (HASP) – Document prepared by the Contractor in accordance with Specification Section 01351 and Federal, State and Local regulations.

Indiana Department of Environmental Management (IDEM) – Responsible for HWMU closure activities.

Lagoon – See "Surface Impoundment"

Material Storage Building (MSB) – Former facility structure (decontaminated and demolished in 2009) that contained the indoor waste pile HWMUs.

Off-Site Surface Stone Aggregate – Imported AASHTO #3 coarse aggregate used for restoration of surface stone areas on the Citizens Gas property that may be disturbed during remedial construction activities. See Specification Section 02936, Part 2.8.2.

On-Site Surface Stone Aggregate – Coarse aggregate utilized as the final 6-inch thick surface covering on those portions of the RMC owned property not designated for drainage ditch, containment cell, turf, or sod. On-Site Surface Stone Aggregate shall meet the requirements for Granular Fill.

Pre-Construction Meeting – Meeting requested by property owners affected by the proposed work, for the purpose of describing the planned activities, answering property owner questions and securing property owner consent. At a minimum the attendees shall include representatives of the Contractor and RMC. (See Specification Section 01200).

Project Meetings - Meetings hosted by the Contractor on a weekly basis at a regularly scheduled time and location for the purpose of reviewing work completed during the previous week, planned work for the upcoming two week period, technical issues and problems, progress towards meeting schedule and related issues affecting the work. (See Specification Section 01200).

Quality Assurance (QA) – Planned and systematic process of observing, testing inspecting and/or evaluating the Quality Control activities performed by the Contractor manufacturers, material suppliers, installers and subcontractors. QA activities are performed by the QA Representative.

QA Representative – Full-time construction monitor retained by RMC for the purpose of observing and documenting construction activities, conveying information between the Contractor, Engineer and RMC, interpreting the CMD during implementation and representing the on-site interface with regulators and general public.

Quality Control (QC) – Actions taken by manufacturers, material suppliers, installers and the Contractor to evaluate and demonstrate attainment of performance criteria established in the CMD. See Specification Section 01400.

RMC- Refined Metals Corporation

Sediment – General term utilized to distinguish between solid matrix samples collected from areas of concentrated surface water runoff and other site areas. Use of the term in the CMD is not limited to ecological habitat or bed-load found in surface water drainage feature but also includes soils.

Structural Soil Fill – Material utilized for construction of Containment Cell berms, filling to create the perimeter access road subgrade, backfill around the storm water management basin outlet structures and pipes, and backfilling excavations greater than 2 feet deep. Structural Soil Fill shall meet the requirements established in Specification Section 02210, Part 2.1.

Submittal Register – Document prepared and maintained by Contractor following award of Contract identifying the planned/required submissions. (See Specification Section 01300).

Surface Impoundment – Hazardous Waste Management unit located north east of the form office building and utilized for the management of storm water runoff.

USEPA – United States Environmental Protection Agency. Responsible for corrective measures of on-site and off-site areas, except those areas designated as HWMUs.

1.0 INTRODUCTION

1.1 GENERAL

Presented herein is the design report describing the proposed Corrective Measures to be completed by Refined Metals Corporation (RMC) to address elevated concentrations of lead and associated inorganic compounds in soil, sediment and groundwater identified on and around the RMC facility in Beech Grove, Indiana. The design report, in conjunction with the design drawings, specifications, Construction Quality Assurance Plan, and other attachments, comprises the Corrective Measures Design (CMD). The CMD is being submitted pursuant to the requirements of a Consent Decree negotiated between RMC, the United States Environmental Protection Agency (USEPA) and Indiana Department of Environmental Management (IDEM) Civil Action No. IP902077C.

This submission of the CMD is intended to represent a Final level of completion. The format and level of detail of the CMD process represent a hybrid between the highly structured requirements identified in the Consent Decree, and the single submission format requested in the Final Decision Document. As agreed upon between representatives of RMC, USEPA and IDEM, the Preliminary submission presented the major design components at approximately a 20 to 30% level of completion to obtain regulatory consensus. This Final submission has been developed to advance the amount of detail to a level of 100%. The general configuration of the major design components presented in the Preliminary submission (including containment cell location; excavation limits and confirmatory sampling techniques; pre and post-remediation storm water management strategies; and anticipated permitting requirements) have not changed. This submission includes attachments presenting construction specifications; Construction Quality Assurance Plan; Inspection and Maintenance Plan (including groundwater monitoring plan); engineering calculations; cost estimates; and construction schedule. The design drawings have been advanced to include additional details and schematics, sequence of construction information, and construction notes.

1.2 BACKGROUND

The Refined Metals Corporation (RMC) Beech Grove facility (Site) was the location of a secondary lead smelting and refining operation from 1968 through 1995. The general location of the Site is shown on Figure 1 and a detailed plan of the Site is shown on Sheet 1 of the design drawings. During its operational life, the facility handled hazardous materials or hazardous wastes under the Resource Conservation and Recovery Act (RCRA). These primarily consisted of lead acid automotive and industrial batteries, and lead-bearing materials that were processed for lead recovery.

In accordance with the requirements of RCRA, the facility completed and submitted a RCRA Part A permit application. On November 19, 1980 the facility was granted approval to operate two hazardous waste management units under Interim Status: 1) indoor waste piles; and 2) outdoor waste piles. Facility documents also identify a surface impoundment (lagoon) as a RCRA permitted unit; however, the lagoon does not appear to have been included on the Facility Part A permit until after 1991. The lagoon was, and still is, used to collect and manage facility storm water runoff. See Sheet 1 of the design drawings for the location of the RCRA Hazardous Waste Management Units (HWMUs).

The former indoor and outdoor waste piles were removed when normal facility operations ceased. The site sat idle after December 31, 1995 except for the wastewater treatment system which remained in operation to collect and manage storm water runoff from the lagoon and other site areas. Between August 2009 through early-January 2010, all buildings and structures were decontaminated and demolished, with the exception of four pump houses and the lagoon which remained in operation for on-site storm water management. Decontamination and demolition activities were performed in accordance with the *Draft Decontamination and Demolition Plan* (Advanced GeoServices March 4, 2009) and the *Decontamination and Demolition Implementation Plan* (Focus Contracting, June 8, 2009) both of which were submitted, reviewed and approved by the USEPA and IDEM. A summary report of the decontamination and demolition activities is being prepared on a parallel track with preparation of this CM Design submission and will be included as an attachment to the Corrective Measures Completion Report to be provided following completion of the Corrective Measures. The summary report will describe the methods utilized for decontamination, the waste streams produced (including estimated quantities) and identify the final disposition (disposal or recycling) of the materials generated.

Throughout the decontamination and demolition process, storm water from the impervious former manufacturing area continued to be collected, treated as appropriate, and discharged to the City of Indianapolis POTW. The impervious ground surfaces within the former manufacturing areas (former pavement surfaces and remnant floor slabs) were cleaned as part of the decontamination and demolition activities. Storm water inlets/manholes, piping and pump house sumps were cleaned following final cleaning of the impervious Site surface areas to remove sediment and rinse water what may have been washed into the storm water system.

Storm water sampling performed after completion of site cleaning activities has demonstrated that storm water from the lagoon and cleaned surface areas of the site can be discharged without requiring pre-treatment. In an effort to reduce the hydraulic loading on the POTW, the City of Indianapolis requested that RMC cease discharge of the clean storm water to the sanitary sewer following completion of decontamination and demolition activities. In response, RMC submitted a request for a "No Exposure Certification for Exclusion from NPDES Storm Water Permitting" to allow surface discharge of the storm water been sent to the POTW. IDEM approved the request in May 2010 and since that time RMC has discharged storm water to the drainage ditch at the north end of the property using the existing system of pumps and internal conveyance piping. The existing pump houses and collection system (inlets and piping) will be demolished and/or sealed/plugged and the site regraded to gravity drain storm water as part of the corrective measures and HWMU closure site restoration activities. Demolished components will be salvaged (pumps and controls), recycled, and or disposed in the containment cell.

1.3 PURPOSE

On August 31, 1998 Refined Metals Corporation entered into a Consent Decree with the United States Environmental Protection Agency (USEPA) and the Indiana Department of Environmental Management (IDEM), Civil Action No. IP902077C. The technical objectives of the Consent Decree are as follows:

1. Effectuate closure of waste piles and surface impoundment by submitting a closure plan and post-closure plan, if necessary, and then to implement the plan(s) as approved;

2. Perform a RCRA Facility Investigation (RFI) to evaluate and determine the full nature and extent of releases and collect information necessary to support a Corrective Measures Study, or Interim Measures;

3. Perform Interim/Stabilization Measures to abate threats to human health and the environment;

4. Perform a Corrective Measures Study to develop and evaluate alternatives and to recommend a final corrective measure(s); and,

5. Perform Corrective Measures.

1.3.1 Waste Pile and Surface Impoundment Closure Investigations

Pursuant to Section VI, Paragraph 37 of the Consent Decree (Compliance Requirements for Closure), Advanced GeoServices Corp. (AGC) prepared a Closure Plan on behalf of RMC for the HWMUs. The Closure Plan was prepared in accordance with Indiana Department of Environmental Management (IDEM) Hazardous Waste Management Unit Closure Guidance (Waste-0013-ND) and Risk Assessment Addendum.

The Closure Plan (Version 3.0 dated July 17, 1999) was implemented between the fall of 1999 and spring of 2000. The results of the investigation conducted pursuant to the approved Closure Plan were presented in the Closure Investigation Report (AGC, June 2000). Comments on the Closure Investigation Report prompted additional soil sampling within the HWMUs in December 2001, January 2007 and August 2007. Results of the Closure Investigation activities were compiled in a Comprehensive Closure Investigation Report (AGC March 27, 2007), with an addendum containing supplemental sampling information on January 29, 2008 and a response to IDEM comments on April 8, 2008.

1.3.2 RCRA Facility Investigation

Pursuant to Section VI, Paragraph 42 of the Consent Decree (Compliance Requirements for Corrective Action), RMC prepared and implemented a RCRA Facility Investigation (RFI) Work Plan (AGC March 3, 1998) which was conditionally approved by the USEPA in writing on June 3, 1999. The RFI Work Plan was revised by AGC on July 7, 1999 in response to the USEPA conditional approval. Final USEPA approval of the RFI Work Plan was received in a letter dated August 17, 1999. The USEPA approved RFI Work Plan was implemented by AGC on behalf of RMC in late 1999 and early 2000. A Phase I RFI Report was submitted by RMC on August 31, 2000. Based on the results of the Phase I RFI and as required by the USEPA, a Phase II RFI Work Plan was prepared and submitted (AGC December 20, 2000). Following minor revisions (based on USEPA comments) in an addendum dated June 27, 2001, the Phase II RFI Work Plan was approved by the USEPA on July 13, 2001. The Phase II RFI Report was prepared and submitted by AGC on May 3, 2002 and subsequently revised in November 18, 2002.

1.3.3 Interim Corrective Measures

Results of the Phase I RFI identified elevated concentrations of lead in the shallow surface soil/sediment along the former railroad spur entering the facility from the railroad tracks north of the site. To reduce the potential for that soil/sediment to be eroded and transported to areas off-site RMC prepared a Interim Measures Work Plan (AGC December 20, 2000), consisting of a series of check dams across the drainage ditch that was approved by the USEPA on July 13, 2001. AGC implemented the Interim Measures Work Plan in September 2001. Those measures remain in-place to date and based on visual observations provide detention and filtration to storm water flow in the ditch. The check dams will remain in-place until remediation is performed in the drainage ditches on either side of the railroad spur. No other interim measures were performed or required at the facility.

1.3.4 Corrective Measures Study

The Corrective Measures Study (CMS) was performed in two phases pursuant to a CMS Work Plan (AGC April 21, 2003), as revised by AGC on July 11, 2003 and October 16, 2003 and conditionally approved by USEPA on November 5, 2003. The Phase I CMS consisted of supplemental soil sampling (including shallow surface soil in the mowed grass swale along South Arlington Avenue and drainage ditch along the CSX railroad tracks referred to in the RFI, CMS and herein as "sediment") and groundwater sampling (completed by AGC during the fall of 2003), and completion of a Baseline Human Health Risk Assessment (BHHRA) (performed by Gradient Corporation (Gradient)). The BHHRA separated the site into two exposure areas identified as "Grassy Areas" and "On-Site Areas". Figure 2 shows the specific areas represented by Grassy Areas and On-Site Areas. The results of the Phase I CMS were initially submitted in a report prepared by AGC on June 22, 2004. The USEPA issued written comments on August 17, 2004 and January 18, 2005 and the Phase I CMS Report was revised on May 6, 2005 and approved in writing by the USEPA on August 23, 2005.

The Phase II CMS consisted of the development and evaluation of cleanup options for those areas of the site impacted above action levels established in the BHHRA and accepted in writing by the USEPA in their approval letter dated August 23, 2005. The Phase II CMS also anticipated remediation of surface soils and sediment with total lead concentrations >400 mg/kg in the right-of-way for South Arlington Avenue, Citizens Gas property along the south side of the Citizens Gas security fence parallel Big Four Road, and drainage ditch within the CSX right-of-way. The Phase II CMS Report was originally submitted by AGC on October 21, 2005. The Phase II CMS Report was revised by RMC through a series of iterations promulgated by USEPA comment letters issued on April 19, 2006, July 13, 2006, November 30, 2006, March 1, 2007 and May 29, 2007. Conditional approval of the August 6, 2007 revision of the Phase II CMS Report was issued by the USEPA in a letter dated January 22, 2008.

1.3.5 Corrective Measures Design

This Corrective Measures Design (CMD) is being submitted to convey the design and construction elements of the Corrective Measures alternatives selected by the USEPA from the Phase II CMS Report and published in the Statement of Basis (USEPA June 2008). As agreed to by USEPA, IDEM and RMC, the CMD approach deviates from both the highly structured approach specified in the Consent Decree, and the single submission format specified in the Final Decision Document. It is believed that the agreed upon approach will both allow for regulatory input during the design process, while expediting the design schedule. The Preliminary Design representing approximately a 20 to 30% level of completion was submitted to USEPA and IDEM on January 8, 2010. Comments on the Preliminary CMD were received in written format in a letter dated February 25, 2010. The USEPA determined that based on the limited scope of comments on the Preliminary CMD that an "on-board" review meeting was not necessary prior to Pre-Final CMD preparation. On April 12, 2010, a Pre-Final CMD was submitted to the USEPA and IDEM. The Pre-Final CMD represented an approximately 90% level of completion. On June 10, 2010, the USEPA and IDEM issued comments regarding the Pre-Final CMD. This Final CMD reflects EPA and IDEM's comments regarding the Pre-Final CMD.

It should also be noted that pursuant to discussions between USEPA, IDEM and RMC it was agreed to include Closure of the Interim Status Hazardous Waste Management Units (Indoor Waste Piles, Outdoor Waste Piles and Surface Impoundment) as a component of the CMD. Inclusions of the Closure activities within the CMD allows the design efforts for both proposed remediation activities to proceed in parallel and provides USEPA relevant information regarding the Closure activities, and IDEM relevant information regarding the Corrective Measures. Additional information regarding the interrelationship between the USEPA and IDEM and the Corrective Measures and Closure is provided in Section 3.0.

1.4 ORGANIZATION

This Preliminary design report is organized as follows:

- Section 1.0 - Introduction (provided above);
- Section 2.0 - Facility Background, including operating history and regulatory status;
- Section 3.0 – Regulatory Purview;
- Section 4.0 – Nature and Extent of Contamination;
- Section 5.0 – Statement of Basis;

- Section 6.0 – Design Elements;
- Section 7.0 – Permitting Requirements;
- Section 8.0 – Public Relations;
- Section 9.0 – Schedule and Cost Estimate;
- Section 10.0 - Post Corrective Measures Storm Water Management; and,
- Section 11.0 – Post Closure Inspection and Maintenance.

2.0 FACILITY BACKGROUND

2.1 FACILITY LOCATION

The RMC facility is located at 3700 South Arlington Avenue in Beech Grove, Marion County, Indiana, and approximately four miles south-southeast of downtown Indianapolis. The Site occupies approximately 24 acres, of which approximately 10 acres represented the active manufacturing area (including paved areas and buildings). The remaining 14 acres include grass and wooded areas. The configuration of the Site is triangular, bounded by South Arlington Avenue (oriented in a north to south direction representing the hypotenuse), Big Four Road (along the base), and the common property line with a natural gas company (Citizens Gas) forming the third side. The northwest end of the triangle is truncated by a railroad right-of-way as depicted on Sheet 1 of the design drawings.

The Site is relatively flat with less than 10 feet of total relief. Natural site drainage is toward the north and east. The former manufacturing area included nearly 80,000 square feet (sf) of structures including the battery breaker, a wastewater treatment plant, a filter press, material storage building, a furnace room, metals refining area warehouse, a vehicle maintenance structure and offices. As indicated in Section 1.2, all of the structures were decontaminated and demolished to grade between August 2009 and January 2010, except the pump houses which were decontaminated but remain to manage storm water. Decontamination and demolition activities were performed in accordance with the *Draft Decontamination and Demolition Plan* (Advanced GeoServices March 4, 2009) and the *Decontamination and Demolition Implementation Plan* (Focus Contracting, June 8, 2009) both of which were submitted, reviewed and approved by the USEPA and IDEM. Summary information regarding the decontamination and demolition activities will be included as an attachment to the Corrective Measures Completion Report to be provided following completion of the Corrective Measures. As stated in Section 1.2, the summary report will include descriptions of the decontamination procedures, waste streams produced and final disposition of the materials sent off-site for disposal or recycling.

The floor slabs, foundations and site paving remain in-place. Debris resulting from the demolition activities was sent off-site for recycling or disposal, except for non-hazardous masonry rubble that was placed under a geomembrane cover within the footprints of the former battery breaker and material storage buildings to prevent infiltration of stormwater, create positive drainage and prevent the ponding of surface water. The paved surface areas drain toward catch basins situated around the Site. The catch basins in-turn, flow to the storm water pump houses. Originally, the storm water from the former manufacturing areas of the Site was discharged to the POTW by the pump houses. Since IDEM approval of a "No Exposure Certification for Exclusion from NPDES Storm Water Permitting" in May 2010, RMC has discharged storm water to the drainage ditch at the north end of the property using the pump houses. The existing pump houses and collection system (inlets and piping) will be demolished and the site regraded to gravity drain storm water as part of the corrective measures and HWMU closure site restoration activities. Demolished components will be salvaged (pumps and controls), recycled, and or disposed in the containment cell.

2.2 OWNERSHIP HISTORY

The Site was reportedly undeveloped woodlands until 1968. In 1968, the property was developed as a secondary lead smelter by National Lead. National Lead operated the facility from 1968 through 1980, when it was sold to Exide Corporation. In 1985, the Site was purchased from Exide Corporation by RMC. RMC continued to operate the facility until the cessation of operations on December 31, 1995. From April 14, 1995 through December 31, 1995, operations were reduced to enriching and casting lead ingots from off-specification lead products. Since 1996, no production has taken place at the facility and operations have been limited to operation of the wastewater treatment facility which was used to manage storm water runoff from the former manufacturing areas prior to 2009 demolition activities.

2.3 REGULATORY HISTORY

As stated above, following the promulgation of RCRA, the facility submitted a Part A RCRA permit application. On November 19, 1980 the facility was granted Interim Status as a hazardous waste treatment, storage and disposal facility. The RCRA Subtitle C units included indoor and outdoor waste piles (used to store batteries and lead-bearing wastes), and the 750,000-gallon concrete lined lagoon. A Part B application was submitted during the mid-1980s, although full RCRA permitted status was never granted. The EPA maintains that interim status was lost on November 8, 1985 as a result of RMC's alleged failure to comply with Section 3005(e)(2) of RCRA, 42 U.S.C. 6925(e)(2); RMC did not agree with this allegation.

RMC submitted a revised Part A application on October 26, 1988 requesting an increase in the storage volume for spent batteries. The request was granted on September 20, 1989. A subsequent revised Part A application was submitted to IDEM on December 7, 1990 for an additional increase in the storage volume of spent batteries, but IDEM denied the increase. RMC filed for a stay and was granted interim status. IDEM approved the revised Part A application on June 3, 1991 with the provision that it did not grant interim status under RCRA. The Part B application was not resubmitted. In 1994, the facility withdrew its Part A and Part B permit applications.

A site inspection was performed under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) in 1980. In 1985, a preliminary assessment was performed under CERCLA. No further action was planned under CERCLA at that time.

3.0 REGULATORY PURVIEW

3.1 SEPARATION OF RESPONSIBILITIES

As stated above, the Consent Decree includes the United States Environmental Protection Agency (USEPA) and the Indiana Department of Environmental Management (IDEM) as regulatory participants. Section VI Paragraph 37 of the Consent Decree (Compliance Requirements for Closure) places responsibility for oversight of closure of the interim status hazardous waste management units (indoor waste piles, outdoor waste piles and surface impoundment (lagoon)) under IDEM. Oversight of work in all other areas is the responsibility of the USEPA. This has resulted in parallel investigation activities and slightly different remediation requirements, with the IDEM responsible for "Closure" of those portions of the RMC property contained within the footprint of the HWMUs and USEPA responsible for "Corrective Measures" of remaining on-site areas and all off-site areas.

3.2 HWMU CLOSURE

Irrespective of the slightly different remediation requirements, this Corrective Measures Design has been developed to include remediation required to affect Closure of the HWMUs. Closure activities specific to the HWMUs are presented separately in Section 6.4 of this Design Report and limits of soil remediation are depicted on Sheet 6 of the design drawings. HWMUs are being remediated to attain Closure to the default Industrial Closure Levels for soil, and groundwater at the lagoon, as established under the IDEM RISC Technical Guidance (Last Revised May 1, 2009) except for arsenic and lead in soil where alternate values will be utilized.

Results of soil sampling conducted within the footprints of the HWMUs are provided on Sheet 3 of the design drawings. Groundwater monitoring for the lagoon has been performed pursuant to the requirements of a Groundwater Monitoring Plan approved by IDEM (AGC, June 8, 2007). A discussion of the results of this groundwater sampling and groundwater sampling conducted in conjunction with the RFI is provided in Section 4.5 of the CMD.

3.3 CORRECTIVE MEASURES

The Corrective Measures activities related to soils and sediment to be completed under the purview of the USEPA are being performed specifically for lead. Within the off-site areas readily accessible by the general public, the remediation level for soil and sediment is 400 mg/kg total lead. On-site, soil remediation will be performed to achieve an area wide Preliminary Remediation Goal of 920 mg/kg. For site wide groundwater, the standards will be 0.010 mg/L for arsenic and 0.042 mg/L for lead, the same values to be applied to groundwater for Closure of the lagoon. The site wide groundwater values were previously identified in the Phase II CMS Report as approved by USEPA.

The Final Decision issued by the USEPA determined that a commercial/industrial cleanup standard applies to the neighboring Citizens Gas property and agreed with RMC's interpretation that except for a drainage ditch along the north side of the Citizens Gas property and soil remediation outside the security fence parallel to Big Four Road, no remediation is required on that property and placement of a deed restriction is the only action required as part of the Corrective Measures. RMC has been in discussions with representatives of Citizens Gas for the purpose of negotiating the language and implementation of the deed restriction. Although not required as part of the Corrective Measures, Citizens Gas has requested and RMC has agreed to perform a limited amount of surface soil remediation in conjunction with granting the deed restriction. RMC is planning to perform the surface soil remediation during the Corrective

Measures and HWMU Closure activities. Remediated soils from the Citizens Gas property will be consolidated in the containment cell.

Results of soil sampling conducted off-site are provided on Sheet 3 of the design drawings. A discussion of the results of the groundwater sampling conducted in conjunction with the RFI is provided in Section 4.5 of the CMD and is provided in Tables 1A through 1L. Sampling and evaluation of data being performed in relation to the Monitored Natural Attenuation (MNA) of lead and arsenic in groundwater are considered components of the RCRA Corrective Measure as they have been specified by the USEPA (rather than by IDEM as part of the HWMU closure), and are described in detail in the MNA Work Plan provided as Attachment H.

4.0 NATURE AND EXTENT OF CONTAMINATION

4.1 CONSTITUENTS OF CONCERN IN SOIL AND SEDIMENT

4.1.1 RCRA Facility Investigation

Environmental sampling, performed as part of the Phase I RCRA Facility Investigation (RFI) (sample locations RSB-01 through RSB-85) included sampling for arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver. While the results of the Phase I RFI sampling detected the presence of barium, cadmium, chromium, mercury, selenium and silver, with only some exceptions; concentrations of these parameters were consistently below the Region 9 Preliminary Remediation Goals (PRGs) used for screening results of the Phase 1 RFI sampling in the corrective action areas (i.e., areas outside the boundaries of the HWMUs). Therefore, only lead and arsenic were retained as constituents of concern in soil and sediment in corrective action areas. The Baseline Human Health Risk Assessment (BHHRA), performed as part of the Phase II RFI and revised during the CMS, focused exclusively on lead and arsenic. A detailed summary of the investigation activities and results are provided in the Phase I and Phase II (Revision 1.0) RCRA Facility Investigation Reports (Advanced GeoServices August 31, 2000 and November 18, 2002, respectively) and relevant addenda and response to comments. The final BHHRA is provided as an appendix to the Phase II CMS Report.

4.1.2 Closure Investigation

In addition to lead and arsenic, soil sampling performed as part of the Closure Investigation for the interim status Hazardous Waste Management Units (HWMU) indicated that antimony, cadmium and selenium are present in soil immediately beneath the HWMUs in some sample locations at levels exceeding the IDEM RISC Technical Guidance default values for soil. Therefore, antimony, cadmium and selenium are considered constituents of concern, in addition to lead and arsenic within the HWMUs. Results of the Closure Investigation are presented in the Comprehensive Closure Investigation Report (Revision 1.0) (Advanced GeoServices March 27, 2007) and supplemental data submitted in January, 2008.

4.2 BEHAVIOR OF LEAD AND RELATED CONSTITUENTS

A number of the materials formerly used at the facility have toxic characteristics; however, the principal material of concern is lead. Lead is a common metal, and can be found at an average concentration in excess of 30 ppm in natural soils and 1-10 ug/l in surface water. Most lead salts are fairly insoluble in water; however, the solubility depends on the pH, with solubility increasing in more acidic conditions. Movement of lead in soils depends on its adsorption, chelation with organic matter, and the precipitation of the less soluble salts. In general, lead reacts with soil anions or clays to form insoluble complexes, inhibiting its mobility. Lead can be ingested or absorbed by inhalation. Poisoning from acute exposure to lead is uncommon. The primary toxic effects from chronic exposure are on the blood and the nervous system. Antimony, arsenic, cadmium and selenium are all considered insoluble inorganic constituents and their behavior is generally similar to the behavior lead. The only notable difference is that arsenic is naturally occurring in regional soils at levels that have been noted to exceed the IDEM RISC Technical Guidance default values and arsenic is relatively more soluble than lead.

4.3 DISCUSSION OF SOURCE AREAS

Based on the documented operating history of the facility, results of the Closure and RFI sampling activities, and an understanding of the character of the mobility and transport of lead and arsenic, the most significant potential sources of contamination impacting surface and shallow subsurface soils at the facility during its operating history were erosion and transport of lead-bearing solids; fugitive dust; and filling performed using impacted soils or slag resulting from the furnace operations. Sampling activities were designed to target the areas of impact from each of the potential sources. Soil and sediment sample locations are depicted on Sheet 2 and the results of the sampling are provided on Sheet 3. A supplemental qualitative discussion regarding the sampling results is provided below.

4.4 EXTENT OF IMPACT

4.4.1 Drainage Ditches

Erosion and transport of lead bearing solids from sources, such as the outdoor waste piles or materials tracked from operating areas of the facility may have occurred before the facility was upgraded to capture and treat storm water falling in the active manufacturing areas of the facility. The impacts associated with the erosion and transport of lead impacted solids would be manifested in the form of elevated concentrations within drainage paths leading from the facility. Sampling was conducted in the drainage ditches along the railroad spur and tracks north of the former manufacturing area ("northern drainage ditch"), along the north side of the main driveway, and along South Arlington Avenue. The sampling focused on the centerline of the drainage ditches and identified soil/sediment impacted by lead in excess of 400 mg/kg. In the northern drainage ditch, lead exceeded 400 mg/kg to a distance of approximately 600 feet west of the northwest corner of the RMC property; in the driveway drainage ditch, lead exceeded 400 mg/kg along the entire length; and along South Arlington Avenue, lead exceeded 400 mg/kg from approximately 1,000 feet north to 1,000 feet south of the main driveway.

4.4.2 Surface Soil

Fugitive dust emissions are generated by traffic, wind and similar sources that cause dust on the ground surface, exposed waste materials and/or materials from production areas to become suspended in air and transported. Generally the particulate size of fugitive dust is large and as a result, the area impacted by the fugitive dust is relatively limited. Sampling determined that fugitive dust has caused some impacts to the surface soils on the adjacent Citizens Gas property west of the facility manufacturing area. Impacts from fugitive dust were not identified in off-site areas north, south and east of the facility, where the property boundaries are typically 200 feet or greater from the former manufacturing area.

A BHHRA was conducted for an exposure scenario intended to replicate workers at the Citizens Gas facility, the results of which were included in the Phase II CMS Report. The BHHRA evaluated the potential for the receptor to have adverse impacts from arsenic (using the 95% UCL) and lead (using the mean lead). The results of the risk assessment for arsenic determined that the total excess lifetime cancer risk on the Citizens Gas property is 8x10-6, with a Total Hazard Index of 0.05, which did not represent an unacceptable risk. The lead risk assessment predicted a 95th percentile fetal blood lead level (BLL) of 7.4 ug/dL, which is below the allowable maximum of 10 ug/dL. Through the BHHRA is was determined that lead and arsenic did not represent an unacceptable risk for the non-residential exposure scenarios evaluated on the Citizens Gas property and, therefore; remediation was not required as part of the Corrective Measures. As required by the Final Decision, RMC and Citizens Gas have been negotiating a deed restriction against future residential development of the property. Citizens Gas has agreed to record the required deed restriction if RMC performs remediation of a limited amount of surface soils. RMC has agreed to perform the remediation requested by Citizens Gas. RMC is planning to perform the surface soil remediation on the Citizens Gas property during the Corrective Measures and HWMU Closure activities and to consolidate the remediated soils in the containment cell.

4.4.3 Subsurface Soil

During the early operating history of the facility, feed materials destined for recycling and waste products resulting from the recycling process (i.e. slag) were managed on the unpaved exterior surfaces. As a result, shallow subsurface soils have become intermixed with materials containing high concentrations of lead. In addition, various modifications and expansions of the manufacturing area were conducted periodically that required minor amounts of grading. The results of these activities are elevated concentrations of COCs in the shallow subsurface soils. In most areas the depth of impact is less than 12-inches, with a few areas extending up to 36-inches. The only areas deeper than 36-inches are within the HWMU along the northern limits of the manufacturing area where areas of filling and disturbance are as much as 8-feet below existing ground surface. It was also determined that an area within the material storage building HWMU had impacted soil requiring remediation as deep as 6-feet.

4.4.4 Storm Water Lagoon

The storm water lagoon is an interim status HWMU. Sampling was conducted to characterize the nature of sediments within the lagoon and the impact of the lagoon on underlying soils. The results of the sediment sampling (CSED-1 through 4) in the lagoon identified concentrations of antimony, arsenic, cadmium and lead above the IDEM RISC industrial soil default values. The sediment is typically 6-12 inches in thickness and overgrown by cattails. The lagoon is lined by a geomembrane in poor condition and concrete. Sampling conducted during the initial investigation activities included the collection of soil samples from beneath the liner system (CSB-43 through 47). The results of that sampling identified one sample with an arsenic concentration slightly above the proposed cleanup level. It should also be noted that samples of storm water collected from the lagoon during and after decontamination and demolition activities did not exceed the discharge limits established by the temporary discharge permit and were included as part of the results that formed the basis for IDEM authorization for surface discharge of storm water.

4.5 GROUNDWATER IMPACTS

Groundwater conditions have been evaluated through the installation and sampling of twelve (12) shallow and two (2) deep monitoring wells. Monitoring well locations are shown on Figure 3. Groundwater in the shallow zone of saturation near the former manufacturing area occurs as perched zones within thin, laterally discontinuous layers of sand and sandy silts contained in clayey-silt and silty-clay glacial deposits. The monitoring wells identified as "deep" are screened within a middle perched zone located 75 to 85 feet below ground surface. "Depth to water" measurements indicate that the potentiometric surface of the middle perched zone is on the order of 14 to 17 feet below ground surface, while the shallow perched zone is typically less than 5 feet below the ground surface.

The results of groundwater sampling conducted as part of the RFI, Closure Investigation and CMS are provided in Tabular format on Tables 1A through 1L. The results for arsenic and lead are screened against the IDEM Industrial Default RISC Criteria 10 ug/L and 42 ug/L, respectively. (The 10 ug/L value for arsenic is the same as the MCL for arsenic). The remaining constituents are screened against the MCLs. A groundwater contour map is provided for the (January 2007) site wide sampling event on Figure 3. Total results for lead and arsenic from the January 2007 groundwater sampling event for the shallow groundwater wells are also presented on Figure 3.

A review of shallow groundwater sample results, obtained as part of the RFI and Closure activities (Tables 1A through 1L), shows that the current MCL for arsenic (10 ug/L) has been exceeded on more than one occasion at groundwater monitoring wells MW-1, MW-2, MW-3, MW-7, MW-8 and MW-10. The 42 ug/L IDEM Industrial Default RISC Criteria for lead is exceeded in unfiltered samples on more than one occasion in MW-2 and MW-7. With the exception of MW-3, each of the wells that exceed the IDEM Industrial Default RISC Criteria for arsenic or lead is located within or immediately adjacent to an area of the Site identified to contain some of the most deeply impacted soils.

MW-3 has had two total arsenic results at 11 ug/L, one total arsenic result at 28 ug/L and a result of 170 ug/L. The available filtered results for MW-3 have all been below 10 ug/L and field logs from the sampling event corresponding to the 170 ug/L (January 2007) result indicate that the turbidity of the sample was so high that the turbidity probe indicated an erroneous reading. Field parameters for all wells are also provided in Tables 1A through 1L. Recognizing that MW-3 was constructed in 1990, that the site soils have a naturally high arsenic content and that MW-3 is located in an area of the Site not associated with the recycling and smelting operations, the arsenic exceedances observed in MW-3 are believed to be a reflection of turbidity in the well and not water quality.

Although results of the groundwater sampling did not reveal site wide groundwater impacts, results did detect arsenic and lead above screening levels utilized for this project. Therefore, USEPA has requested that shallow groundwater be included as a component of the Corrective Measures for the site. The Constituents of Concern for groundwater are lead and arsenic. The selected remedy for groundwater is monitored natural attenuation (MNA). Section 5.5.2 and Attachment H provide a description of the groundwater sampling to be performed as part of the MNA.

5.0 STATEMENT OF BASIS

5.1 GENERAL

The results of soil and sediment sampling conducted as part of the RFI and site specific risk assessment performed during the CMS have determined that lead is present in soil and sediment on the site at concentrations that could represent an unacceptable risk to future occupants and therefore; require corrective measures. The RFI sampling conducted in off-site areas identified concentrations of lead in surface soil and sediment greater than the USEPA Region Screening Level (RSL) for residential exposure to lead in soil and although a site specific risk assessment did not indicate a currently unacceptable risk within these areas, RMC has agreed to the USEPA's request to also perform corrective measures. Soil sampling performed as part of the Closure investigation also identified concentrations of lead and associated inorganic compounds in shallow subsurface soils beneath the pavement and floor slabs of the former indoor and outdoor waste piles. RMC must also close the storm water lagoon.

5.2 CORRECTIVE MEASURES

As stated above, the entire Site, except for those portions within the footprint of the HWMUs, is under the regulatory purview of the USEPA and was the subject of a Corrective Measures Study (CMS). The CMS included a human health risk assessment that evaluated specific non-residential exposure scenarios for the Site and proposed remediation alternatives for review and consideration by the USEPA. The Corrective Measures alternatives selected in the Statement of Basis issued by the USEPA are the excavation of soil above a Remedial Action Level (RAL) calculated to achieve an exposure area wide Preliminary Remediation Goal (PRG) and consolidation of the remediated soil in an on-site containment cell.

The soil PRG calculated by the risk assessment for the Site is 920 mg/kg. The risk assessment evaluated the Site as "Grassy" and "On-Site" exposure areas (Figure 2) and using the results of RFI and Closure sampling calculated RALs as follows:

- 4,954 mg/kg total lead in "grassy" areas; and,
- 8,470 mg/kg total lead in paved areas.

A deed restriction against future residential or other development inconsistent with the risk assessment exposure assumptions will be filed with the Site deed.

For soil and sediment in off-site areas accessible to the general public, RMC has agreed to perform excavation activities to a remediation level of 400 mg/kg total lead. Attainment of the proposed remediation concentrations will be based on post excavation sampling. The protocol for performing the sampling and interpreting the results is provided in the CQAP (Attachment D).

5.3 HWMU CLOSURE

The HWMU areas are RCRA Subtitle C Interim Status units. As stipulated in the Consent Decree, the HWMU areas are being closed under the regulatory purview of IDEM. RMC is proposing to perform the closure activities concurrent with the Corrective Measures and will be consolidating the remediated soils and sediment into the proposed on-site containment cell.

As documented in Advanced GeoServices Corporation's (AGC) September 24, 2008 letter to IDEM, it is RMC's intention to "clean close" the HWMUs. Based on the IDEM RISC Technical Guidance Industrial Default Closure Values, the target closure concentrations ("Standards") to be applied for the HWMUs are summarized as follows:

Parameter	Soil Standard	Groundwater Standard
Antimony	37 mg/kg	NA
Arsenic	20 mg/kg*	0.010 mg/L
Cadmium	77 mg/kg	NA
Lead	970 mg/kg**	0.042 mg/L
Selenium	53 mg/kg	NA

Notes:

*** The Soil Standard proposed for arsenic represents the "Direct Soil" value contained in RISC Industrial Closure Levels Table A (IDEM May 1, 2009). This value will be utilized over the default value of 5.8 mg/kg (based on Migration to Groundwater). Justification for use of the alternate value based on soil sampling which demonstrated a background arsenic concentration of 12.7 mg/kg and site specific SPLP testing which demonstrates an average partitioning coefficient more than an order of magnitude greater than the portioning coefficient utilized to calculate the default Migration to Groundwater value. This represents a modification of the value for arsenic proposed in the September 24, 2008 letter to IDEM.**

**** The Soil Standard proposed for lead represents the "Construction" value contained in RISC Industrial Closure Levels Table A (IDEM May 1, 2009). This value will be utilized over the default value of 230 mg/kg (based on Migration to Groundwater). Justification for use of the alternate value is based on site specific SPLP testing which demonstrates an average partitioning coefficient more than an order of magnitude greater than the portioning coefficient utilized to calculate the default Migration to Groundwater value.**

Standards are not shown for barium, chromium, mercury or silver, as these parameters were not indentified during Closure sampling at concentrations greater than the default Industrial Closure Levels for soil or groundwater, as established under the IDEM RISC Technical Guidance (Last Revised May 1, 2009). Standards for antimony, cadmium and selenium are limited to values for soil only as none of these constituents was detected at concentrations above the their respective default Industrial Closure Levels for groundwater, as established under the IDEM RISC Technical Guidance (Last Revised May 1, 2009).

Attainment of the proposed closure levels within the HWMUs will be based on post excavation sampling. The protocol for performing the sampling and interpreting the results will be based on procedures contained in the IDEM RISC Technical Guidance for default closure sampling (RISC Technical Guidance Section 6.3). The target potential exposure concentration (PEC) for the bottom of the excavations will be 970 mg/kg total lead. Specific information regarding the closure sampling are provided in the CQAP (Attachment D), but in general the intent is to demonstrate that the 95-percent upper confidence limit (UCL) of the mean for the samples (collected randomly) representing a specific closure area is at or below the PEC.

5.4 CONTAINMENT CELL

Pursuant to the Statement of Basis issued by the USEPA, the containment cell will be situated in the northwest corner of the Site. The containment cell will be defined by a perimeter soil berm, have a soil bottom and be capped with a composite cap system. The composite cap will consist of (from top to bottom) a vegetative cover, erosion control mat, 6-inches of topsoil, 18 inches of compacted soil, double sided composite drainage net, 60 mil textured geomembrane and non-woven geotextile placed on a smooth, compacted soil subgrade. The drainage net will terminate in an anchor trench constructed in the perimeter soil berm. The anchor trench will contain a perforated pipe in a stone annulus designed to drain water from the drainage net to the surrounding ground surface.

Cover soil sliding and interface stability calculations have been performed and are provided in Attachment C. Those calculations have been performed for the "worst-case" slope condition based on the maximum cell grading (β = 33%, H=16 ft and L=48 ft) and an assumed minimum interface friction angles and soil unit weight (Φ=22° and σ =120 lb/ft^3). Collectively these values provide an interface factor of safety of 1.22. These are assumed values and must not be relied upon for final stability. As described in Specification Section 02751, interface friction testing ("shear box testing") must be performed utilizing the actual geosynthetic liner materials and cover soil fill proposed for use by the Contractor for cap construction. The shear box testing will be performed at confining pressures of 0.5, 1.5 and 3.0 psi for each interface (cover soil to geocomposite; geocomposite to textured geomembrane; textured geomembrane to geotextile; and geotextile to sub soil) and the result utilized to estimate the residual friction angles for each interface. If the results are less than 22°, the factor of safety will be less that 1.2 and the interface will be considered "unstable". If an unstable interface exists, RMC will have the option of requiring the Contractor to perform testing of alternate materials until acceptable interface friction values are achieved or modifying finished grading of the containment cell to attain the minimum required factor of safety.

As a result of the change in the containment cell location required by the Statement of Basis, sufficient space is available to allow an increase in the size of the cell foot print from approximately 1.15 acres to 1.44 acres (as measured at the anchor trench). At the maximum 3:1 grading shown on Sheet 5, cell capacity will be approximately 25,679 cubic yards; sufficient volume to accommodate all of the soil and sediment currently proposed for remediation as part of the Corrective Measures and HWMU Closure and still provide additional excess capacity for soils from the Citizens Gas property and/or additional material generated on-site as a result of additional excavation performed within area of failing confirmatory sampling results. In the event the additional airspace it not required, the larger footprint will allow the finished containment cell to have a lower profile cap than the maximum configuration shown on Sheet 5. If insufficient air space is available to accommodate all remediated soil and sediment, excess materials will be sent for off-site disposal. Sheet 5 also shows the completed cap with the minimum required finished cap slope of 3%. The associated volume for the minimum grading is <6,000 cy.

5.5 GROUNDWATER

Groundwater sampling conducted as part of the RFI has identified concentrations of arsenic in the shallow perched groundwater above 10 ug/L on more than one occasion in MW-1, MW-2, MW-3, MW-7, MW-8 and MW-10; and lead concentrations above 42 ug/L on more than one occasion in MW-2, and MW-7. The Statement of Basis issued by the USEPA, requires RMC place a deed restriction on the property against the use of groundwater from the Site as a potable water source. The Statement of Basis also selected Monitored Natural Attenuation (MNA) as the approach to restoring groundwater quality. MNA is predicated on an improvement of groundwater quality following completion of the proposed soil remediation activities. In addition, RMC must install and sample a system of groundwater monitoring wells capable of monitoring groundwater quality in the vicinity of the containment cell for indications of groundwater degradation.

5.5.1 Containment Cell Groundwater Monitoring

During the initial stages of Corrective Measures implementation, RMC will have groundwater monitoring wells MW-7 and MW-10 and the former facility production well abandoned. Permanent abandonment shall be in accordance with the requirements established in 312 Indiana Administrative Code 13-10 (Rule 10). Rule 10 requires that abandonment activities be performed by a water well driller using a neat cement, bentonite slurry, or crushed or pelletized bentonite. Notification of abandonment will be filed by the well driller within 30 days following completion of plugging activities. Immediately following construction of the containment cell perimeter access road, RMC will install six new shallow wells to monitor groundwater quality in the shallow perched zone beneath and in the general vicinity of the proposed containment cell. The proposed well locations, labeled as CC-1 through CC-6, are identified on Sheet 4 of the design drawings. The new wells and remaining existing wells will be surveyed by a professional surveyor retained by RMC to ensure all groundwater measurements are utilizing the same vertical and horizontal datum. The containment cell monitoring wells (CC-1 through CC-6 and MW-2) will be subject to at least one round of groundwater sampling prior to and/or coincident with corrective measures construction and then routine monitoring following completion of corrective measures construction as part of long term Inspection and Maintenance activities.

5.5.2 MNA Groundwater Monitoring

As summarized in Section 4, groundwater sampling has identified concentrations of arsenic > 10 ug/L in MW-1, MW-2, MW-3, MW-7, MW-8 and MW-10; and concentrations of lead >42 ug/L in MW-2 and 7. Pursuant to the Statement of Basis, RMC will conduct sampling at designated wells for the purpose of determining if concentrations are increasing, decreasing or stable, and to collect data regarding groundwater parameters that directly impact groundwater geochemistry. The groundwater monitoring wells to be included as part of the MNA groundwater monitoring network will consist of MW-1, MW-2, MW-3, MW-8, MW-9 MW-12, and CC-1 through CC-6.

Detailed information regarding the proposed MNA activities is provided in the MNA Work Plan (Attachment H).

6.0 DESIGN ELEMENTS

6.1 PREPLANNING, PERMITTING, AND ACCESS

The selected Contractor will be required to provide a detailed construction schedule presenting his proposed approach to the project. The schedule, with appropriate backup information, will reflect the Contractor's approach to the project including the anticipated sequence of construction, estimated times for completion, assumed production rates, critical path and milestones. The schedule will also demonstrate their understanding of intrinsic design elements. The construction schedule will not be subject to regulatory approval, except to the extent the Contractor's approach or sequence may significantly deviate from the CMD as currently proposed. Acceptance of the schedule by RMC will not be considered approval of a variance from the CMD or other requirements of the Contract unless specifically approved in writing by RMC. Copies of the schedule will be provided to the USEPA and IDEM prior to the start of work.

A pre-construction meeting between representatives from RMC, the Contractor, owners of property which will be remediated, and the appropriate Agencies will be held at the Site prior to the onset of active remedial activities. During the pre-construction meeting, the Contractor will present his approach to the project including schedule and sequence of work and address questions and concerns.

Remedial activities will not begin until the necessary permits are granted and required Notice of Intent (NOI) letters (erosion and sediment control) have been submitted to and approved by IDEM. A list of the required permits has been identified and is included in Section 7.0.

Access to off-site areas requiring remediation will be secured prior to the onset of corrective measures. Amtrak and CSX were contacted during preparation of the Pre-Final Design to determine limitations and restriction associated with excavation or construction activity within railroad right-of-ways and to discuss any additional considerations regarding work in close proximity to their tracks. Through those contacts, it was confirmed that CSX is the owner of the right-of-way for the tracks north of the site and Citizens Gas; however; information received from Amtrak indicates that they do not own the tracks between Big Four Road and the Citizens Gas fence. A review of the Marion County Indiana Tax Assessors office determined that the property between the southern fence for Citizens' Gas and Big Four Road is owned by Citizens Gas.

Relative to work in the CSX right-of-way, RMC is providing additional design details for their review. The proposed excavation is a minimum of 25 feet from the closest rail and the depth of proposed removal are outside the "theoretical railroad embankment line" (a 1:1.5 line that extends out and down from a point located 12 feet from the centerline of the track) that would require sheeting and shoring. Requirements for the access by equipment and personnel between the tracks and proposed excavation will also require that the Contractor carry specific railroad insurance and have a CSX approved flagman present during the work to control access and train traffic. To protect the track on the property owned by Citizens Gas, no excavation will be performed within the theoretical railroad embankment line. The theoretical railroad embankment line has been plotted on excavation cross-sections provided on Sheet 12.

Work within the right-of-way of South Arlington Avenue will require that the Contractor obtain a right-of-way permit. Typically these would be issued through the City of Beech Grove but because South Arlington Avenue is identified as a "primary arterial road" additional approval from the City of Indianapolis may be necessary.

6.2 SITE PREPARATION, DUST CONTROL AND STORM WATER MANAGEMENT DURING CONSTRUCTION

Site preparation activities will include establishment of the support zone, installation of erosion control measures, implementation of dust control measures and air monitoring, mobilization and activation of temporary water treatment equipment and utility location and abandonment, as needed. Exclusion and contaminate reduction zones will be designated to mitigate cross contamination. Equipment and personnel decontamination stations will be instituted to minimize the potential of contaminant release. Traffic routes and access will be established for transport of contaminated materials between excavation areas and the containment cell.

Clearing and grubbing of the containment cell location and other excavation areas within the northern wooded area will be required to facilitate equipment access. Roadways will need to be established for material transport. These areas will require grading such that erosion and sediment control is maintained.

Dust control measures will be selected by the Contractor based on the means and methods proposed for completion of the project. In general, these are expected to include the use of water to wet the ground surface and areas of excavation. During decontamination and demolition activities the contractor mobilized large spray-misters that utilized fans and water spray to wet the work zone in the surrounding area and to help suppress dust. The contractor also utilized a water truck on a nearly continuous basis during dry weather to keep site pavement wet. Section 02115 of the Specifications provides additional information related to dust control and Section 02999 provides requirements for dust control and air monitoring.

Storm water management and erosion controls will be performed in accordance with applicable standards and practices as set forth in the Indiana Storm Water Quality Manual and the Indianapolis Storm Water Design and Construction Specifications Manual. Storm water during construction activities can be characterized as follows: storm water runoff from areas of exposed soils and sediment requiring remediation (i.e., active excavations) and storm water runoff from areas not designated for remediation or where remediation is already completed (i.e. "clean areas").

Storm water associated with active excavations, and decontamination water, will require collection and treatment prior to discharge to the POTW through the existing sanitary sewer. Collected water requiring treatment at a minimum will be processed through a series of bag filters. The Contractor will determine the exact configuration and filtration requirements necessary to meet the discharge requirements established by the POTW and determine if additional treatment is necessary. Storm water and decontamination water will be treated in batches and stored in tanks until approved for discharge by the Engineer based on analytical results representing the treated batch. To the extent possible, the Contractor will utilize treated water for dust control purposes in an attempt to reduce the volume of water discharged to the POTW. The maximum batch size shall be 30,000 gallons. The maximum discharge rate to the POTW will be 90 gallons per minute or as otherwise dictated under the Special Discharge Permit. The limits for discharge of water to the POTW will be established under the Special Discharge Permit and therefore the exact parameters and values can not be determined at this time. However, for comparison purposes the following parameters and limits were required for the decontamination and demolition activities:

- pH 5.0 to 12.0 S.U.
- Arsenic 4.0 mg/L
- Lead 4.7 mg/L
- Zinc 36.0 mg/L
- TPH 200 mg/L

Storm water from the clean areas will not require collection and management, except to the extent required to control erosion, avoid entry into active excavations and work zones, and prevent uncontrolled runoff to adjacent property. The Contractor will utilize the existing pump and piping system to convey clean storm water runoff from the existing sump areas to the drainage ditch along the CSX right-of-way. The Contractor will sequence his work to ensure the four pump houses will remain in operation as long as possible during construction or he will establish new temporary pumping to continue water management. During excavation and restoration activities in the CSX drainage ditch, the Contractor will be required convey the storm water to a location down stream from the disturbed section of the drainage ditch.

The lagoon will cease to be used for storm water management when closure of the lagoon begins. The current paved surfaces at the Site have been cleaned as part of the decontamination and demolition project and the associated storm water runoff is approved for discharge without treatment. If an area contributing runoff to one of the pump houses or collection area established by the Contractor becomes re-contaminated, the Contractor will be required to analyze the accumulated water from that pump house and demonstrate the water still meets the appropriate discharge criteria. If the water does not meet the discharge criteria the Contractor will be required to collect and treat all storm water flowing to that pump house.

Storm water from the "grassy" areas, will continue to be managed by utilizing existing drainage features such as the perimeter swales. The construction within the grassy areas and swales will be sequenced such that remediation in the upslope areas is completed before down slope areas. This will help prevent recontamination. The design requires restoration of remediated swales using either grass sod or geotextile and stone each of which allows immediate re-stabilization of the remediated areas.

6.3 CONTAINMENT CELL CONSTRUCTION

The containment cell will be situated in the northwest corner of the Site, as shown on Sheet 5 of the design drawings. The containment cell will be 330 feet long by 190 feet wide defined by the centerline of an 8 feet wide earthen berm. The berm will have a top of berm elevation of 843.0 and an interior bottom elevation of 841.5.

A review of potentiometric groundwater levels collected at MW-10 since installation in 2003 shows the groundwater elevation within the vicinity of the proposed containment cell varies between 833.24 (October 2007) and 841.25 (April 2005). Based on a direct comparison, this means the groundwater has ranged from 8.26 feet below to 0.25 feet below the proposed cell bottom elevation. The vertical separation during periods of seasonally high groundwater is expected to be greater than minimum observed 0.25 feet based on the knowledge that grading performed as part of containment cell construction will enhance the currently poor surface water drainage while the impermeable barrier created by the cap essentially eliminates infiltration.

Proposed finished grades will be no steeper than 3 horizontal to 1 vertical (33%) and no flatter than 33 horizontal to 1 vertical (3%). The maximum proposed elevation of the top of cap will be 862.5 +/-. The maximum grading shown on Sheet 5 of the design drawings for the top of waste and top of cap represents the maximum filling configuration and provides a waste disposal capacity of approximately 25,679 cubic yards. The total combined volume of soil, sediment and miscellaneous debris to be excavated is approximately 18,000 cubic yards. This includes approximately 5,000 cy of soil from the HWMUs, approximately 6,000 cy of soil from other on-site areas, approximately 5,000 cy of on-site debris and approximately 2,000 cy of off-site soil and sediment (excluding material from Citizens Gas).

The containment cell berm will be located 50 feet from the northern and western property boundaries as measured from the centerline of the proposed berm. The area between the berm and property line will be utilized to accommodate a perimeter access road and swale. The access road will provide access for sampling the proposed groundwater monitoring wells and maintaining the swale. The swale will collect runoff from the west and north sections of the containment cell cap and convey it into the outlet structure for main storm water management basin. The remainder of the cap and storm water from the majority of the former manufacturing area will drain directly to the storm water management basin located east of the cell. The invert elevation of the lowest outlet device for the basin will be 837.25; during periods of higher groundwater, the basin may also convey some groundwater.

Construction of the cell will require minor cutting and filling to create the swale, berm and access road. Existing groundwater monitoring wells MW-7 and MW-10 will be abandoned by RMC prior to the start of Corrective Measures construction. Permanent abandonment of groundwater monitoring wells MW-7 and MW-10, and permanent abandonment of the former facility production well (located near the former warehouse) shall be in accordance with the requirements established in 312 Indiana Administrative Code 13-10 (Rule 10). Rule 10 requires that abandonment activities be performed by a water well driller using a neat cement, bentonite slurry, or crushed or pelletized bentonite. Notification of abandonment will be filed by the well driller within 30 days following completion of plugging activities.

Existing trees will need to be cleared and grubbed from the proposed containment cell and storm water management basin area. Cleared and grubbed material (trees and shrubs) will be sent off-site for disposal. Excavation areas NW and ND1 will be dug to the vertical and horizontal limits shown on Sheet 7 and the resulting spoils (approximately 1,000 CY) stockpiled to await placement in the containment cell. After completion of remediation in NW and ND1 the topsoil will be stripped from the remaining area and placed in 500 cy (maximum) stockpiles. The volume of topsoil to be stripped is uncertain, but assuming an average thickness of 8-12 inches, is expected to be on the order of 3,000 to 5,000 cy.

After removal of the topsoil, cutting and filling of native soils will be performed to achieve the design grades necessary to define the perimeter access road, swale, containment cell and storm water management basin. No confirmatory sampling is required prior to commencement of cutting and filling except as required within excavation areas NW and ND1. Depending on the average thickness of topsoil removed it may be necessary to import structural soil fill (Specification Section 02210) to complete the required grading. If excess native soils remain after completion of required grading excess materials shall be stockpiled (500 cy max) and characterized to determine the acceptability for use as backfill elsewhere on-site.

General procedures for stockpile sampling are provided in the Sampling and Analysis Plan portion of the Construction Quality Assurance Plan (Attachment D). Stockpile samples will be analyzed for lead, arsenic, antimony, cadmium and selenium (Method 6010). Analytical results for arsenic, antimony, cadmium and selenium will be compared against the soil standards listed for HWMU Closure in Section 5.3 of the CM Design Report. Lead will be compared against the 920 mg/kg PRG calculated by the BHHRA and the 400 mg/kg residential soil screening value being used for lead in soil within the public and railroad right of way. Stockpiles with results below the HWMU soil standards for arsenic, antimony, cadmium and selenium and less than 400 mg/kg lead can be utilized as backfill anywhere on-site. Stockpiles with results below the HWMU soil standards for arsenic, antimony, cadmium and selenium and between 400 mg/kg and 920 mg/kg total lead can be utilized as backfill anywhere on-site except within drainage features and the storm water management basin. Stockpiles with results that exceed the HWMU soil standards for arsenic, antimony, cadmium and selenium or have >920 mg/kg lead will be placed in the containment cell or sent off-site for disposal.

Containment cell filling will be performed in lifts. Lifts will have a maximum loose lift thickness of 18-inches and each lift will be compacted until visually stable as determined by the QA Representative. Filling will be sequenced to contain storm water runoff from the exposed waste surface and the contractor will be required to collect and treat standing water prior to placement of subsequent lifts. Access into the cell will be provided from the south end and equipment entering the cell and running across areas of exposed soil will be required to clean the wheels before exiting the cell. The Contractor is encouraged to utilized designated equipment in the cell and dump materials destined for the cell without actually entering the cell.

6.4 HAZARDOUS WASTE MANAGEMENT UNIT CLOSURE

6.4.1 Surface Impoundment

The surface impoundment (lagoon) is an Interim Status RCRA Hazardous Waste Management Unit (HWMU) that is subject to the Closure requirements contained in 40 CFR 265.228. The Contractor will remove standing water in the lagoon. The Contractor may elect to transfer the water directly to holding tanks for testing or process the water through the temporary water treatment system prior to placement in the tanks and testing. The accumulated sediment and vegetation will be removed and placed in the on-site containment cell. Throughout sediment removal the Contractor will continue to collect and manage water draining from the sediment. After removal of liquid, bulk sediment, vegetation, the liner and miscellaneous debris, the Contractor will demolish the concrete component of the liner. Demolition of the concrete liner will be performed from the perimeter of the lagoon and work inwards taking care to minimize disturbance to the subsoils.

Cement concrete (including masonry) will be crushed to the gradation requirements for Granular Fill specified in Specification Section 02210 or Surface Stone specified in Section 02936, separated into stockpiles (not exceeding 500 cubic yards each) and sampled (see stockpile sampling requirements in the Sampling and Analysis Plan portion of the Construction Quality Assurance Plan (Attachment D)). To determine the acceptability of the material for use as fill the samples will be analyzed for lead, arsenic, antimony, cadmium and selenium (Method 6010). Analytical results for arsenic, antimony, cadmium and selenium will be compared against the soil standards listed for HWMU Closure in Section 5.3 of the CM Design Report. Lead results will be compared against the 920 mg/kg PRG derived by the BHHRA and the 400 mg/kg residential soil screening value being used for lead in soil within the public and railroad right of ways. Crushed concrete and masonry stockpiles with results below the HWMU soil standards for arsenic, antimony, cadmium and selenium and less than 400 mg/kg lead can be utilized as Granular Fill or Surface Stone anywhere on-site. Crushed concrete with results below the HWMU soil standards for arsenic, antimony, cadmium and selenium and between 400 mg/kg and 920 mg/kg total lead can be utilized as Granular Fill anywhere on-site except within the drainage features or the storm water management basin. Stockpiles with results that exceed the HWMU soil standards for arsenic, antimony, cadmium and selenium and/or with >970 mg/kg lead will be placed in the containment cell or sent off-site for disposal. Crushed concrete sent for placement in the containment cell may not be placed within 12-inches of the final top of waste unless crushed to a maximum particle size <1.5 inches.

Previous sampling of soil beneath the concrete liner produced results that were all below the action levels being applied to closure of the HWMUs except for a single sample (CSB-37 A (0-3 inches)) which had an arsenic concentration of 25 mg/kg. This result is only slightly above the action level for arsenic of 20 mg/kg and in consideration of the associated lead result of 58 mg/kg, is believed to be a reflection of variability in background arsenic concentrations rather than impacts from former facility operations. Therefore, no soil remediation is proposed within the footprint of the lagoon. The Engineer will collect soil samples from the soil immediately beneath the concrete following the procedures established in the CQAP for confirmatory sampling at the bottom of excavations. The results will be evaluated as confirmatory samples against the soil standards established for the HWMUs in Section 5.3 of the CM Design Report.

6.4.2 Former Waste Pile Locations

Those areas of the Site horizontally utilized for the management of feed materials for the recycling operation and resulting solid waste materials were designated as waste piles in the facility Part A filing and granted interim status under RCRA. The waste pile areas were subject to focused sampling as part of the Closure Investigation and were also subject to a limited amount of additional sampling as part of the site wide RCRA investigation. The locations and results of the borings are provided on Sheets 2 and 3 of the design drawings, respectively. Additional discussions of the design elements for the former waste piles are provided separately below based on those that were indoors and those that were outdoors.

6.4.2.1 **Outdoor Waste Piles**

The Outdoor Waste Piles consist of six separate areas (number 1 through 6) as shown on Sheet 1 of the design drawings. The total combined area of the Outdoor Waste Piles is approximately 1.8 acres. Records indicate that the outdoor waste piles were originally utilized to store lead bearing materials waiting processing recycling and waste products (primarily slag) awaiting off-site disposal. The existing ground surface of the outdoor waste piles is characterized by bituminous concrete (asphalt) or Portland cement concrete pavement. The only remnant structures within the footprint of the Outdoor Waste Piles are two former equipment pedestals in area 1 (near the northwest corner of the Material Storage Building (MSB)) and Area 5, the former loading dock of the MSB. During the recent facility demolition, all paved site surfaces were cleaned to remove debris and sediment.

Thirty-one soil borings were conducted within the footprint of the Outdoor Waste Piles as part of the Closure Investigation plus seven borings performed as part of the RFI. To meet the closure criteria established for the HWMUs, soil remediation will be required at the areas depicted on Sheet 6 of the design drawings. As shown, excavation depths range from no removal to 7.25 feet, as measured from the existing ground surface.

Closure of the Outdoor Waste Piles will consist of removing the pavement covering the area to be remediated taking care to segregate the concrete pavement (including curb) from the asphalt pavement and separating the pavement from the subbase materials. After removal of the pavement, the Contractor will selectively excavate the underlying soil to the target removal depths. Spot elevations will be obtained at designated locations on the existing ground surface, prior to removal of the pavement and utilized as control points to guide the depth of excavation activities. The segregated asphalt pavement and excavated soil will be sent directly to the containment cell, placed in lifts and compacted to provide a stable surface. The segregated concrete will be crushed, placed in stockpiles (500 cy max.) and characterized for possible reuse as granular fill. Remnant concrete structures or foundations that may be encountered during excavation activities will be cleaned using hand tools to remove soil before being sent for crushing.

To document attainment of soil standards applicable to the HWMU Closure, post-excavation confirmatory sampling will be performed at the bottom of the excavations and along the side walls that are inside the footprint of the HWMUs. Sidewall sampling will not be performed on sidewalls that coincide with the horizontal limits of the HWMUs. Adequacy of sampling outside the limits of the HWMUs will be determined based on post-excavation confirmatory sampling requirements for on-site corrective measures described in Section 6.5. Post-excavation sampling will be performed in accordance with the procedures established in the Construction Quality Assurance Plan (Attachment D).

Following approval of confirmatory sampling information by the QA Representative, the resulting excavation will be backfilled with granular fill or structural soil fill to the proposed finished grades. Materials utilized for backfill within the limits of the Outdoor Waste Piles shall meet the remediation requirements for the HWMUs. The Contractor will protect the remediated area against cross contamination from surrounding areas.

6.4.2.2 **Indoor Waste Piles (Material Storage Building)**

The indoor waste piles were located in the Material Storage Building (MSB). The MSB was located at the north end of the main building (see Sheet 1). The MSB was approximately 165 feet by 165 feet with an enclosed corridor into the adjacent Furnace Room. The interior of the MSB included multiple bins used to store lead battery components awaiting processing through the furnace and various other raw materials (such as coke, iron and limestone or crushed concrete) also used in the smelting process. The MSB had concrete floors (typically 6 to 8 inches thick) sloped to drain from the exterior walls inward. During the various investigation activities, the concrete floor was observed to be degraded in the north central portion of the building, presumably a result of the acid in the lead battery feed material reacting with the concrete. The areas of greatest degradation coincide with the areas of proposed deepest excavations as shown on Sheet 6 of the design drawings.

As part of the recently completed decontamination and demolition activities, the 4 to 5 feet high concrete walls forming the exterior of the building and defining the interior bins were demolished to grade. The floor was filled with up to 18 inches of concrete rubble from other areas of the site that had been cleaned and crushed and then covered with a 20 mil PVC geomembrane. The crushed concrete was placed to create positive drainage for precipitation falling on the PVC geomembrane to the storm water collection system. The geomembrane is protected against wind uplift by approximately 300 to 400 sand bags. An estimated 500 to 600 cubic yards of crushed concrete rubble were placed over the MSB floor.

Closure of the indoor waste pile is expected to be one of the initial remedial activities to be performed after preparation of the disposal cell. Closure will consist of removing the PVC geomembrane and excavation of the crushed concrete rubble; removal of the concrete floor and excavation of underlying soils to the depths specified on Sheet 6 of the design drawings. The removal of the geomembrane, crushed concrete rubble and concrete floor will be performed in sections of a size to be determined by the Contractor based on his means and methods for construction. The geomembrane will be cut into sections no larger than 30 feet by 30 feet and placed flat (panels may be folded but not crumpled) in the bottom of the containment cell. The crushed concrete rubble and debris resulting from removal of the floor will be placed in the Containment Cell in loose lifts not to exceed 18-inches thick. Each lift will be compacted to provide a stable surface before the placement of subsequent lifts.

"Soil" removal within the MSB will be to a minimum depth of 12-inch (as measured from the top of the concrete pad) over the entire MSB footprint with specific areas as shown on Sheet 6 of the design drawings to depths as great as 72-inches. The total estimated removal volume within the MSB (excluding the rubble placed during decontamination and demolition) will be approximately 1,400 cubic yards (cy); including 700 cy of concrete representing the floor and 700 cy of soil and crushed aggregate excavated from beneath the concrete floor. The Contractor will be required to obtain spot elevations from the top of the concrete floor prior to removal for use in controlling depth of excavation. Confirmatory sampling will be performed at the bottom of the excavations and along side walls that are inside the footprint of the HWMUs to document attainment of closure criteria. Sidewall sampling will not be performed along sidewalls that coincide with the boundaries of the HWMUs where the exterior boundaries are not adjacent to other HWMUs.

Following approval of confirmatory sampling information by the Engineer, the resulting excavation will be backfilled with crushed stone or soil to the proposed finished grades. Backfill materials generated on-site and utilized for backfill within the limits of the MSB and other HWMUs shall meet the HWMU remediation criteria. Imported backfill material shall meet the IDEM RISC Residential Default Criteria. The Contractor will protect the remediated area against cross contamination from surrounding areas.

6.5 ON-SITE CORRECTIVE MEASURES

On-site corrective measures pertain to non-HWMU soil and "sediment" in the excavation areas located within RMC property boundaries as presented in Sheet 7 of the design drawings, excluding excavation within public and railroad right-of-ways. Non-HWMU soil excavation areas included the former manufacturing area (referred to as "On-Site Manufacturing Area" in the BHHRA), lawn and wooded area (referred to "Grassy Area" in the BHHRA) of the Site that are outside of the HWMUs and exceed the calculated RALs of 4,954 and 8,470 mg/kg total lead, respectively. Although referred to as "sediment", the non-HWMU sediment excavation areas are generally mowed lawn on the site and small shallow storm water ditches with little or no actual sediment present in these features and the samples designated as "sediment" were most typically soil.

6.5.1 Soil Excavation

Excavation of on-site soils will require the removal of overlying floors and pavement in areas where subsoils exceed the RAL. Floors and pavement will be removed in a manner that minimizes disturbance of underlying soils. The concrete will be segregated from asphalt pavement and from the underlying subbase materials, crushed, stockpiled and sampled for potential use as excavation backfill. Sampling will be required to determine if the rubble meets backfill standards (see Specification Section 02210). Any rubble that does not meet the

Specifications will be placed in the containment cell or sent off-site for disposal. The areas of floor and pavement to be removed will be limited to only those areas requiring removal of subsoils. The Contractor shall provide sufficient dust control measures to ensure that the requirements for dust control identified in the Specifications and CQAP are met.

Soil excavation activities will be performed using commonly available construction techniques and readily available equipment and qualified labor. As required by the Specifications, the Contractor shall utilize appropriately placed silt fence, construction sequencing, storm water diversion and similar techniques to protect against erosion and transport potentially contaminated sediment from the site.

The Contractor will be required to develop specific measures to minimize the potential release of contaminants during excavation and exposure of on-site workers and off-site individuals in the immediate vicinity of the Site. Engineering controls such as staged construction, water misting for dust suppression, and proper use of personal protective equipment will be employed to mitigate exposures and potential releases during excavation.

6.5.2 Sediment Excavation

Excavation will be performed within the northern drainage ditches and the driveway ditch to remove "sediment" exceeding 400 mg/kg total lead. (As stated above, the drainage swales are generally mowed lawn on the site and small shallow storm water ditches along the CSX railroad tracks). Little or no actual sediment was present in these features. The samples were designated as "sediment" because they came from the bottom of the drainage swale, not because they represented significant bed load in the drainage ditch.

The northern drainage ditches are located along either side of the abandoned RMC railroad spur in the wooded area to the north. Historic activities are assumed to have conveyed surface water from the Site to the drainage ditches, depositing lead impacted solids along their span. The drainage ditches continue to receive storm water from the Site and flow north toward the CSX railroad line to the north. Three check dams consisting of geotextile and stone are located along the ditches. The check dams trap sediment upstream under current flow conditions and allow the passage of storm water downstream. Excavation in this area includes removal of the check dams within the lateral extents of the ditches. The stone, geotextile and accumulated sediment within the check dam will be placed in the containment cell with the remediated sediment/soil. The drainage ditches are located within a heavily wooded area and will require clearing to facilitate equipment access. Excavation to a depth of 12 inches and extending 5 feet on either side of the centerline of the ditches is expected to achieve sufficient remediation. Sediment excavation may require dewatering of the ditches and water removed during excavation will require testing prior to discharge or diversion. Sediment control measures may be required to reduce the potential for further contaminant migration during excavation.

The driveway ditch is located along the northern side of the main entrance to the Site, off of South Arlington Avenue. Boundaries of the ditch are fairly well defined in areas, and the area of proposed excavation is intended to include the ditch and the adjacent lawn area. The area continues to receive surface drainage and removal of standing water may be required prior to or during the course of excavation. Water removed during excavation will require treatment prior to discharge. Sediment control measures may be required to reduce the potential for contaminant migration during excavation.

Excavation in these areas will be performed using commonly available construction techniques and readily available equipment and qualified labor. The Contractor shall implement Best Management Practices (BMPs) during and after excavation activities to prevent erosion.

6.6 OFF-SITE CORRECTIVE MEASURES

Off-site corrective measures are presented in Sheets 7 and 8 of the design drawings and pertain to proposed excavation areas: within the mowed lawn drainage ditch along South Arlington Avenue, mowed lawn section of the Citzens Gas property between Big Four Road and Citizens Gas fence line; within portions of the northern drainage ditch outside of the RMC property boundary along the CSX right-of-way; and on the Citizens Gas property.

6.6.1 Remediation in Public Right-of-Ways

As shown on Sheet 7, approximately 1,500 feet of the mowed lawn drainage feature along South Arlington Avenue will require excavation of soil/sediment exceeding the USEPA residential screening level of 400 mg/kg lead in soil. Excavation will extend from the edge of pavement to the RMC fence line at varying depths of 6 to 18 inches, with depths generally increasing from north to south. Excavations along the South Arlington Avenue pavement deeper than 6 inches will be stepped in 6-inch increments to avoid damage or undercutting of the road way.

Remedial activities along South Arlington Avenue will involve use of the roadway for equipment access and material transport. As identified in this Design Report, a Right-of-Way permit will be required for this work. Under such permit, traffic control measures shall be implemented by the Contractor in accordance with the Indiana Manual of Uniform Traffic Control Devices. At a minimum, traffic control devices shall be installed prior to commencement of operations, be properly maintained and utilized during excavation and restoration activities, and be removed immediately upon completion. Careful consideration of excavation approaches will need to be exercised in this area due to the presence of overhead and subsurface utilities.

Careful planning with regard to weather forecasts and incorporation of erosion control techniques will be essential as this area receives considerable surface drainage.

6.6.2 Remediation Within Railroad Right-of-Ways

As shown in Sheets 7 and 8, remediation within the active railroad right-of-way includes excavation along the CSX line north of the Site. Excavation in the former right-of-way along Big Four Road, represents property owned by Citizens Gas and the track is inactive except for sporadic use by the adjacent Amtrak facility.

Remediation in the CSX railroad right-of-way consists of removal of sediment exceeding 400 mg/kg total lead within the drainage ditch paralleling the tracks, extending approximately 600 feet west of the northwest corner of the RMC property. Excavation in this area will necessitate proper identification of utility locations prior to commencement. Postings indicate that a Fiber Optics line is located along the tree line in this area. Excavation will be performed using conventional construction equipment. Dewatering of the swale and inclusion of sediment control methods may be necessary to facilitate excavation. Due to the geography of the area and close proximity to the tree line, additional clearing may be necessary to access for excavation. Access may best be achieved from the containment cell location.

6.6.3 Citizens Gas Property

Citizens Energy Group (Citizens) will record deed restriction for the Citizens property immediately adjacent to the west side of the site. The deed restriction will be recorded after RMC completes certain work agreed upon by Citizens on the Citizens property. The work is to be performed simultaneously with Corrective Measures Implementation at the site. The deed restriction shall prohibit the use of the Citizens property for any residential purpose including, but not limited to, residences, hotels or motels, hospitals or in-patient medical care, playgrounds or recreational facilities, or daily care facilities (e.g., day care centers, schools, senior citizen facilities, nursing homes, or assisted living facilities). Prior to filing the deed restriction, RMC and Citizens will ensure that the wording of the deed restriction is acceptable to both EPA and IDEM.

6.7 CONTAINMENT CELL CAPPING AND CLOSURE

The final grading of the cap will be dictated by the actual volume of soil, sediment and debris placed, and the results of interface friction testing for the selected cap geosynthetic and soil materials, but the maximum grading will not exceed that shown on Sheet 5 of the design drawings. Maximum slopes will be 33%. As filling progresses to elevations above the top of berm, the Contractor will be required to place temporary diversions to intercept storm water runoff from the exposed materials in the cell and convey that water to the temporary treatment system for processing. When final grades are reached, the finished surface will be smooth graded, rolled and protruding rocks or other objects that could puncture the geomembrane will be remove by the Contractor. Following approval of the finished surface by the QA Representative, the Contractor will be required to protect the area against vehicular traffic except to the extent necessary to deploy the liner components. Any damage to the approved surface will be repaired by the Contractor to the satisfaction of the QA Representative prior to geomembrane placement. The approved surface may be temporarily covered with plastic sheeting or non-woven geotextile until mobilization of the liner installer, provided such measures protect the surface against erosion. Any such temporary cover must be adequately balanced to protect against disturbance by wind or other causes.

The proposed cap will be a non-woven geotextile placed directly on the approved soil surface, a textured 60 mil HDPE geomembrane (Cap Barrier Layer); double sided drainage net (Cap Drainage Layer); 18-inches of compacted soil fill; 6-inches of topsoil; erosion control mat; and vegetative cover. The geomembrane and drainage net components of the cap will terminate in an anchor trench in the top of the berm. Infiltrating precipitation intercepted by the drainage net will be collect in a perforated pipe situated within the anchor trench. The perforated pipe will have outfalls periodically around the perimeter of the berm to discharge collected water. Specification Section 02751 provides requirements the Cap Drainage Layer; and Section 02755 provides requirements for the Cap Barrier Layer.

6.8 BACKFILL AND RESTORATION

6.8.1 Site Security Fence

During containment cell construction activities, the Contractor will be required to erect permanent site security fence along the common property boundary with the CSX right-of-way along the northern boundary of the site. The new fence will begin at the existing corner post for the Citizens Gas security fence and terminate at the existing corner post for the RMC fence along South Arlington Avenue. Actual alignment along the CSX right-of-way will be established based on property line survey to be completed by the Contractor's surveyor. Warning Signs shall be posted along the alignment of the perimeter security fence (new and old) as described in Specification Section 02831.

Additional security fence repairs and/or replacement will be made as required by RMC or required to facilitate proposed construction activities.

6.8.2 Containment Cell Exterior Berms, Drainage Swale and Access Road

The anticipated sequence of construction will result in the exterior berms, access road and drainage features being constructed prior to the start of site-wide and off-site remediation activities. The centerline of the 12 feet wide perimeter access road on the north and east sides of the containment cell will be located 10.5 feet from the western (common property line with

Citizens Gas) and northern property boundary (CSX right-of-way) as field located by the Contractor's surveyor. The access road and drainage swale will be constructed through cutting and filling with structural soil fill following the procedures provided in Specification Section 02210, to achieve a completed stable subgrade surface. The proposed culvert leading from the drainage swale into the storm water management basin outlet structure shall be installed (Specification Section 02720) during access road cutting and filling activities. The access road will have a cross-slope directing surface water runoff from the road to the proposed drainage swale. The access road surface will be stabilized utilizing geotextile fabric and On-Site Surface Stone Aggregate per Specification Section 02936. The area between the property boundary and the outside edge of the access road shall be graded to match existing grades along the fence and restored with On-Site Surface Stone Aggregate. The drainage ditch and outside face of the containment cell berms will be restored using sod installed in accordance with the requirements of Specification Section 02936.

6.8.3 Storm Water Management Basin

The storm water management (SWM) basin will be situated on the east side of the containment cell as shown on the design drawings. The SWM basin will include the sediment fore-bay, intended to receive runoff and enhance sedimentation; and a storm water detention area, intended to hold storm water runoff during controlled discharge. The Contractor is required to collect and manage storm water runoff from active work zones and disturbed areas of the site in accordance with the requirements of Specification Section 02715, to prevent the entry of potentially contaminated sediment or water into the SWM basin. The SWM Basin shall be constructed at time of site preparation after performing required soil remediation in excavation areas NW and ND1, clearing and grubbing, and stripping topsoil within the proposed area of disturbance.

The fore-bay will have a top elevation of 839.5 and bottom of 837.5 and provide approximately 0.5 acre feet of combined water and sediment storage. The fore-bay will excavated after acceptable confirmatory sampling results have been received for the required soil remediation. Spoils generated during fore-bay excavation meeting the geotechnical requirements for structural soil fill can be utilized for construction of the containment cell berm, without the need for stockpiling and characterization sampling. The fore-bay will become inundated with water (either infiltrating groundwater during periods of high groundwater or surface water runoff) shortly after construction and therefore will not be vegetated or lined with stone. Sediment storage capacity of the fore bay will be maintained during corrective measures construction through periodic sediment removal as required based on sediment accumulation. A final cleaning will be performed when on-site soil remediation is completed. Removed sediment will be placed in the containment cell with the Contractor collecting and managing free liquid pursuant to Specification Section 02715.

The storm water detention area will be constructed concurrently with the sediment fore-bay area. The bottom of the detention area will require cutting to achieve required bottom elevations. Topsoil will be stripped, stockpiled and sampled to determine final disposition. The remaining subsoil will be cut as required to achieve the elevations shown on the design drawings. The detention area will have an outlet structure situated as shown on the design drawings. The outlet structure a precast concrete inlet box, will have a 12-inch diameter orifice plate (invert = 837.25) that will function as the discharge device for the detention basin. The 15-inch diameter CPE culvert from the containment cell drainage ditch will be connected directly to the outlet structure. A 15-inch diameter CPE pipe (invert elevation out = 837.15) will convey water from the retention basin and drainage ditch culvert to the railroad spur drainage ditch. The bottom of the retention area of the SWM Basin will be stabilized with On-Site Surface Stone Aggregate, as specified in Section 02936.

6.8.4 Surface Impoundment

Following receipt of acceptable confirmatory sampling results within the footprint of the lagoon and adjacent on-site corrective measures excavation area OE1, the remaining depression will be backfilled and surrounding area restored. Backfilling within the former lagoon footprint will be performed using granular fill or structural soil fill below elevation 840 (as dictated by geotechnical conditions and discretion of the QA Representative) and using structural soil fill above. Care shall be taken to prevent disturbance of the lawn areas outside the exclusion zone fence. Finished grading shall promote drainage of surface water runoff towards the pavement proposed to remain in place (Sheet 9) and is expected require minimal amounts of cutting in the OE1 excavation area. Materials used as backfill will be placed in lifts and compacted in accordance with the project earthwork specifications (Section 02210).

6.8.5 General On-Site Surface Restoration

Following completion of remediation, the Site areas will be regraded to allow surface water to runoff from the site to the drainage ditches along the CSX right-of-way and South Arlington Avenue without the use of the pump houses. Existing pavement will remain in the areas of the site not proposed for soil remediation except to the extent required to facilitate post remediation storm water drainage. Rough grading will be performed by cutting and filling the ground surface remaining after completion of soil excavation activities. The Contractor will be permitted to "borrow" structural soil fill from completed excavation areas FL-2, FL-3, FL-4A and FL-5, and will backfill the resulting excavation with excess topsoil (stripped from within the area of the containment cell and storm water management basin demonstrated to have a total lead concentration <920 mg/kg and antimony, arsenic, cadmium and selenium equal to or less than the HWMU closure values). The volume of borrow will be dictated by the volume of excess topsoil. The finished surface on-site will be restored with On-Site Surface Stone Aggregate, the only exceptions being the areas between the interior and exterior security fences along South

Arlington Avenue which are proposed for turf restoration. On-site drainage ditches will be lined with Drainage Ditch Aggregate. The requirements for drainage ditch aggregate, on-site surface stone, and turf are provided in Specification Section 02936.

6.8.6 Off-Site Backfill and Restoration

Off-site areas will be restored to the pre-remediation condition unless otherwise approved by the property owner. Backfill will consist of imported structural soil and stone and imported topsoil and/or sod. The drainage ditch along South Arlington Avenue will be restored using sod. The drainage ditches along the CSX right-of-way will be restored using rip-rap stone in the bottom and railroad ballast on the embankment and surrounding ground surface. Information regarding the physical and analytical requirements for aggregate and soil used for restoration are provided in the Specifications.

6.9 SITE DEED RESTRICTION

Upon completion of site soil and sediment remediation and associated restoration, RMC will record a restriction on the deed for the RMC property. The deed restriction will restrict the use of the property to only commercial/industrial land use, and prevent installation of on-site potable groundwater wells.

7.0 PERMITTING REQUIREMENTS

This section describes federal, state, regional, and local permits and approvals required for implementation of Corrective Measures. This section also discusses site access and easement agreements or other arrangements with adjoining landowners necessary for implementation of Corrective Measures. A discussion of the application requirements and timeline for each item is provided below.

7.1 FEDERAL PERMITS

At this point in time, no federal permits are anticipated.

7.2 STATE PERMITS

7.2.1 Rule 5 – General National Pollutant Discharge Elimination System (NPDES) Permit for Storm Water Run-off Associated with Construction Activity

Indiana Administrative Code Rule 5 (327 IAC 15-5) is a performance-based regulation designed to reduce pollutants that are associated with construction and/or land disturbing activities. The requirements of Rule 5 apply to all persons who are involved in construction activity (which includes clearing, grading, excavation and other land disturbing activities) that results in the disturbance of one (1) acre or more of total land area.

RMC will submit application under Rule 5, which will include the following:

- Notice of Intent Letter
- Construction Plan

- Project Narrative and supporting documents
- Vicinity Map
- Existing Project Site Layout
- Final Project Site Layout
- Grading Plan
- Drainage Plan
- Storm Water Pollution Prevention Plan
- Post Construction Storm Water Pollution Prevention Plan

7.3 CITY OF INDIANAPOLIS PERMITS

7.3.1 Office of Code Enforcement

7.3.1.1 Drainage

The Office of Code Enforcement (Office) requires that land alterations be compliant with standards and practices that result in proper storm water drainage and sediment control. The Office has indicated through conversation with AGC that a Mass Earthwork Permit may apply for Corrective Measures. The Mass Earthwork Permit is a drainage permit for projects involving earth disturbance without the construction of buildings. As a general rule, all land alterations in industrial developments require:

- Storm water permit application
- Storm water plans
- Technical information report
- Sediment and erosion control plan
- BMP operation and maintenance manual

As per the Office, construction observation services, testing, and 'record' drawings shall be provided for all industrial developments that plan land disturbance of 5 acres or more.

Once construction begins, the Contractor will be responsible for informing and/or notifying the Office's observer assigned to the following:

- Daily work schedule including any changes in schedule
- Prior notification if work is to be performed on weekends and/or holidays
- Date mandrel tests are to be performed
- Date 'as-built' verification is to be performed

The Office, upon request of the Contractor and/or owner, will schedule the final inspection.

As per Office direction, RMC will submit application for a Drainage Permit which will include completion of the following forms:

- Certification Sufficiency of Plan (Drainage)
- Certificate Obligation to Observe (Storm Water)
- Infrastructure Plan Review Submittal

Upon review of RMC's submission, the Office will determine if the Marion County Soil and Water Conservation District will be involved in the review process. Upon approval, the Office will provide RMC with an Approval Letter, which will need to be included in RMC's Notice of Intent (NOI) submittal to the Indiana Department of Environmental Management (IDEM) for Rule 5 General Construction NPDES Permit application.

7.3.1.2 **Improvement Location Permit**

Temporary office trailers will be required to support Corrective Measures activities. A permit will not be required for these trailers as the Office designates "movable, temporary use structures or buildings utilized during construction projects" as specific exemptions that do not necessitate an Improvement Location Permit. However, the Office stipulates that all provisions and regulations of the City of Indianapolis Industrial Districts Zoning Ordinance shall continue to apply to exempted structures and improvements.

7.3.1.3 **Right-of-Way Permit**

RMC will submit application for excavation within the South Arlington Avenue public right-of-way which will include, at a minimum, the following:

- A properly executed permit application, in the form designated by the Marion County Department of Code Enforcement Department, including but not limited to, the following information:
  - The name and address of the contractor responsible for work;
  - The nature of, and the reason for, the work to be performed;
  - The location of the worksite and the dimensions of the excavation;
  - The anticipated length of time to complete the work;
  - The method of traffic control to be used by the applicant at the worksite;
  - An indemnification agreement; and,
  - Any other pertinent information requested by the Department.
- A general liability insurance policy.

- A performance and maintenance bond.

- Approval from the Department if the proposed work involves a sanitary sewer, storm sewer, affects drainage within the public right-of-way, or as required.

7.3.2 Department of Metropolitan Development

7.3.2.1 **Industrial Districts Zoning Ordinance**

The Site is designated as an I-3-S Medium Industrial Suburban District and I-4-S Heavy Industrial Suburban District and the Official Thoroughfare Plan for Marion County designates South Arlington Avenue as a Primary Arterial. The proposed containment cell will fall in both the I-3-S and I-4-S zoning districts. Although not representing a "structure" as defined under the zoning regulations, the cell has been situated to provide 30 feet of set back from the north and west property lines which represent the side and back yards of the property respectively. The setback from South Arlington Avenue, as measured from the centerline of the proposed berm will be approximately 190 feet at its closest point. The areas within the setbacks will be utilized as storm drainage and storm water management controls.

The containment cell does not appear to represent a "use" under the Industrial Zoning Ordinances, although both zoning districts include provisions for "industrial waste disposal facilities." The Performance Standards for both districts state that plans and specifications for proposed industrial waste disposal facilities shall be submitted to, and written approval obtained from, IDEM and the City of Indianapolis, Division of Compliance before an Improvement Location Permit will be issued. The final CMD will be submitted to the City of Indianapolis division of Compliance for written approval.

7.4 CITY OF BEECH GROVE PERMITS

Conversations with the City of Beech Grove and the City of Indianapolis indicate that, due to the nature of corrective measures, jurisdiction of the majority of work to be performed will be with the City of Indianapolis, Division of Compliance. No permits are expected to be required except for temporary facilities mobilized for completion of the work, although the City will be provided copies of the Final CM Design to confirm the representations made during the initial conversations.

8.0 PUBLIC RELATIONS

Refined Metals Corporation (RMC) developed a Community Relations Plan as an attachment to the RFI Work Plan. Components of the existing Community Relations Plan include a document repository (currently located at the Beech Grove Public Library), semi-annual news letters to a specified mailing list, maintaining open communications with local officials, and conducting public meetings when warranted based on the level of public interest.

9.0 SCHEDULE AND COST ESTIMATE

9.1 SCHEDULE

Based on the corrective measures activities anticipated by this Final Corrective Measures Design, RMC is anticipating a construction period on the order of 4 to 6 months, although ultimately schedule will be dictated by the approach of the selected contractor. A critical path style schedule has been developed and is provided as Attachment G.

9.2 COST ESTIMATE

A preliminary construction cost estimate is provided as Attachment F. The cost estimate has been developed using a unit price and estimated quantity format. As shown, the September 2010 estimate is $1,159,744.

10.0 POST CORRECTIVE MEASURES STORM WATER MANAGEMENT

Post corrective storm water management will consist of a gravity storm water system that will convey storm water runoff from the former impervious manufacturing areas of the site and the eastern portion of the proposed containment cell cap through a storm water management basins situated along the east side of the proposed containment cell. The storm water management basin will cover approximately 1.2 acres and have a storage capacity of approximately 80,000 cubic feet. The outlet structure will be a 15-inch diameter reinforced concrete pipe with an invert elevation of 837.25 that discharges into the railroad ditch along the CSX property. The proposed discharge towards the north coincides with the original storm water discharge for the manufacturing areas of the site prior to construction of the storm water collection and treatment system.

Swales will convey the storm water runoff from the restored areas of the site to the storm water management basin as shown on Sheet 6. The total drainage area to the basin is 9.5 acres with an average CN value of 91. Pondpack® was utilized to perform the storm water management calculations following the SCS Unit Hydrograph Method. As presented on the calculations (Attachment C), the basin will detain the storm event and attenuate the flows as follows:

DESIGN STORM	INFLOW (cfs)	OUTFLOW (cfs)	ELEVATION (ft)	STORAGE (Ac-ft)
2	24.9	3.28	838.50	0.594
5	37.31	4.08	838.92	0.946
10	43.51	4.43	839.13	1.132
25	52.78	7.08	839.38	1.367
50	58.93	9.68	839.54	1.512
100	68.12	12.32	839.78	1.742

In addition to the flows through the storm water management basin, approximately fifty percent of the containment cell cap will drain into a trapezoidal swale along the west and north sides of the cell, before draining through a 15" ø culvert. The swale will function as a storm water management basin for the 1.3 acre area as follows.

DESIGN STORM	INFLOW (cfs)	OUTFLOW (cfs)	ELEVATION (ft)	STORAGE (Ac-ft)
2	2.61	1.61	838.37	0.031
5	4.27	2.49	838.66	0.052
10	5.13	2.85	838.79	0.063
25	6.44	3.27	838.99	0.083
50	7.31	3.47	839.10	0.097
100	8.63	3.75	839.28	0.120

11.0 POST CLOSURE INSPECTION AND MAINTENANCE

The post closure inspection and maintenance plan is provided as Attachment E.

TABLES

TABLES

TA[illegible] 1A

SUMMARY OF INORGANIC GROUNDWATER RESULTS

Well MW-1

Refined Metals Corporation

Beech Grove, Indiana

Parameter		IDEM Industrial Default RISC Criteria (µg/L)	MCL (µg/L)	Sampling Events				
				9/21/1999	12/14/1999	9/22/2001	12/10/2001	1/23/2007
Antimony	Total	41	6	10 U	10 U	10 U	10 U	1 U
	Dissolved	41	6	--	--	--	10 U	1 U
Arsenic	Total	10	10	21	25	33	27	24
	Dissolved	10	10	--	--	--	[illegible]	11
Barium	Total	20,000	2,000	96	86	101	93	--
	Dissolved	20,000	2,000	--	--	--	85	--
Cadmium	Total	51	5	0.2 U	0.2 U	0.2	0.2 U	--
	Dissolved	51	5	--	--	--	0.2 U	--
Calcium	Total	NA	NA	--	--	--	--	280,000
	Dissolved	NA	NA	--	--	--	--	280,000
Chromium	Total	310	100	1.8 U	1 U	3.1	4	--
	Dissolved	310	100	--	--	--	8.9 J	--
Iron	Total	NA	*26000	--	--	--	--	5,600
	Dissolved	NA	*26000	--	--	--	--	3,000
Lead	Total	42	15	1.8 U	1 UJ	5.9	3.4	2.5 U
	Dissolved	42	15	--	--	--	1U	1 U
Magnesium	Total	NA	NA	--	--	--	--	120,000
	Dissolved	NA	NA	--	--	--	--	120,000
Manganese	Total	NA	*880	--	--	--	--	160
	Dissolved	NA	*880	--	--	--	--	180
Mercury	Total	31	2	0.2 U	0.2 U	0.2 U	0.2 U	--
	Dissolved	31	2	--	--	--	--	--
Selenium	Total	510	50	9	73	6.1 J	4	--
	Dissolved	510	50	--	--	--	4.9 J	--
Silver	Total	510	*180	0.2 R	0.2 UJ	0.2 UJ	0.2 U	--
	Dissolved	510	*180	--	--	--	--	--
Sodium	Total	NA	NA	--	--	--	--	17,000
	Dissolved	NA	NA	--	--	--	--	17,000
pH				7.44	7.04	6.95	6.85	7.08
Dissolved Oxygen (ppm)				2.61	0.58	0.87	0.72	5.35
Specific Conductivity (mS)				1039	1231	1.317	1.58	1.98
Temperature (°C)				14.9	10	19.11	11.97	9.72
Oxidation/Reduction Potential (mv)				-187	-55	68	25	58
Turbidity (NTU)				43	12.9	129.4	174	55.2

* No MCL exists for iron, manganese, or silver. Value shown represents USEPA Regional tap water screening level

-- The sample was not analyzed for parameter

Qualifiers: U - not detected; J - estimated; R - rejected; UJ - not detected, estimated reporting limit

Indicates result over MCL (for arsenic, antimony, barium, cadmium, chromium, mercury, or selenium) or IDEM Industrial Default Risk Criteria for lead.

The results summarized are from groundwater sampling events performed by AGC following the RCRA Facility Work Plan.

TABLE 1B
SUMMARY OF INORGANIC GROUNDWATER RESULTS
Well MW-2S
Refined Metals Corporation
Beech Grove, Indiana

Parameter		IDEM Industrial Default RISC Criteria (µg/L)	MCL (µg/L)	Sampling Events					
				9/21/1999	12/15/1999	9/22/2001	12/10/2001	10/27/2003	1/24/2007
Antimony	Total	41	6	10 U	10 U	10 U	10 U	10 U	5.2 U
	Dissolved	41	6	--	--	--	10 U	10 U	1.4
Arsenic	Total	10	10	9.8	[illegible]	[illegible]	12	[illegible]	[illegible]
	Dissolved	10	10	--	--	--	9.8 J	[illegible]	5.2
Barium	Total	20,000	2,000	40	45	31	48	44	--
	Dissolved	20,000	2,000	--	--	--	25	22	--
Cadmium	Total	51	5	0.2 U	0.2	0.3	0.4	0.2	--
	Dissolved	51	5	--	--	--	0.2 U	0.2 U	--
Chromium	Total	310	100	1 U	1.6	1 U	4.8	2.1	--
	Dissolved	310	100	--	--	--	6.8 J	3.1	--
Lead	Total	42	15	11 U	18	49	84	44	75
	Dissolved	42	15	--	--	--	6.2	2.9	1.2
Mercury	Total	31	2	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	--
	Dissolved	31	2	--	--	--	--	--	--
Selenium	Total	510	50	7.7	6	2 U	3.1	2 UJ	--
	Dissolved	510	50	--	--	--	3.7 J	2 U	--
Silver	Total	510	180	0.2 R	0.2 UJ	0.2 UJ	0.2 U	0.2 U	--
	Dissolved	510	180	--	--	--	--	--	--
pH				7.29	6.99	6.85	6.85	6.71	6.92
Dissolved Oxygen (ppm)				4.58	0.42	0.73	0.58	0.58	3.06
Specific Conductivity (mS)				1394	1657	1.83	2.09	1.93	1.89
Temperature (°C)				16	10.07	21.05	9.67	13.97	9.94
Oxidation/Reduction Potential (mv)				-43	-50	47	37	1	41
Turbidity (NTU)				8	27.5	21.2	154	8	81.9

* No MCL exists for iron, manganese, or silver. Value shown represents USEPA Regional tap water screening level
-- The sample was not analyzed for parameter
Qualifiers: U - not detected; J - estimated; R - rejected; UJ - not detected, estimated reporting limit
Indicates result over MCL (for arsenic, antimony, barium, cadmium, chromium, mercury, or selenium) or IDEM Industrial Default Risk Criteria for lead.

The results summarized are from groundwater sampling events performed by AGC following the RCRA Facility Work Plan.

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TABLE 1C

SUMMARY OF INORGANIC GROUNDWATER RESULTS

Well MW-3

Refined Metals Corporation

Beech Grove, Indiana

Parameter		IDEM Industrial Default RISC Criteria (µg/L)	MCL (µg/L)	Sampling Events					
				9/22/1999	12/14/1999	9/22/2001	12/11/2001	10/26/2003	1/24/2007
Antimony	Total	41	6	10 U	10 U	10 U	10 U	10 U	1 U
	Dissolved	41	6	--	--	--	10 U	10 U	1 U
Arsenic	Total	10	10	[redacted]	7.8	9.7	[redacted]	[redacted]	[redacted]
	Dissolved	10	10	--	--	--	8.4J	7.5	5
Barium	Total	20,000	2,000	135	127	102	98	84	--
	Dissolved	20,000	2,000	--	--	--	113	73	--
Cadmium	Total	51	5	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	--
	Dissolved	51	5	--	--	--	0.2 U	0.2 U	--
Calcium	Total	NA	NA	--	--	--	--	--	180,000
	Dissolved	NA	NA	--	--	--	--	--	190,000
Chromium	Total	310	100	1.1	1 U	1 U	1 U	1 U	--
	Dissolved	310	100	--	--	--	6.6 J	4.9	--
Iron	Total	NA	*26000	--	--	--	--	--	30,000
	Dissolved	NA	*26000	--	--	--	--	--	1,900
Lead	Total	42	15	1 U	1 UJ	1.3	1 U	1 U	3.9
	Dissolved	42	15	--	--	--	1 U	1 U	0.31 J
Magnesium	Total	NA	NA	--	--	--	--	--	67000
	Dissolved	NA	NA	--	--	--	--	--	70000
Manganese	Total	NA	*880	--	--	--	--	--	120
	Dissolved	NA	*880	--	--	--	--	--	120
Mercury	Total	31	2	0.2 U	0.2 U	0.2 U	--	0.2 U	--
	Dissolved	31	2	--	--	--	--	--	--
Selenium	Total	510	50	5.2	5.3	2 U	1 U	2 UJ	--
	Dissolved	510	50	--	--	--	3.7J	2	--
Silver	Total	510	*180	0.2 R	0.2 UJ	0.2 UJ	--	0.2 U	--
	Dissolved	510	*180	--	--	--	--	--	--
Sodium	Total	NA	NA	--	--	--	--	--	38,000
	Dissolved	NA	NA	--	--	--	--	--	40,000
pH				7.02	6.87	6.97	6.77	6.96	6.94
Dissolved Oxygen (ppm)				1.57	0.47	0.39	0.46	0.54	1.12
Specific Conductivity (mS)				1069	1078	1.098	1.272	1.389	1.34
Temperature (°C)				15.1	13.2	16.9	12.73	13.39	5.68
Oxidation/Reduction Potential (mv)				-97	-52	40	32	25	27
Turbidity (NTU)				24	1.03	16.9	13.9	84.1	>1000

* No MCL exists for iron, manganese, or silver. Value shown represents USEPA Regional tap water screening level

-- The sample was not analyzed for parameter

Qualifiers: U - not detected; J - estimated; R - rejected; UJ - not detected, estimated reporting limit

[redacted] Indicates result over MCL (for arsenic, antimony, barium, cadmium, chromium, mercury, or selenium) or IDEM Industrial Default Risk Criteria for lead.

The results summarized are from groundwater sampling events performed by AGC following the RCRA Facility Work Plan.

TABLE 1D
SUMMARY OF INORGANIC GROUNDWATER RESULTS
Well MW-4
Refined Metals Corporation
Beech Grove, Indiana

Parameter		IDEM Industrial Default RISC Criteria (µg/L)	MCL (µg/L)	Sampling Events					
				9/22/1999	12/14/1999	9/24/2001	12/11/2001	10/26/2003	1/25/2007
Antimony	Total	41	6	10 U	10 U	10U	10U	10U	1U
	Dissolved	41	6	--	--	--	10U	10U	1U
Arsenic	Total	10	10	1.8	1.6	1U	1U	1.3	0.56J
	Dissolved	10	10	--	--	--	1UJ	1U	0.59J
Barium	Total	20,000	2,000	211	204	197	187	276	--
	Dissolved	20,000	2,000	--	--	--	203	213	--
Cadmium	Total	51	5	0.2 U	0.2 U	0.2U	0.2U	0.2U	--
	Dissolved	51	5	--	--	--	0.2U	0.2U	--
Calcium	Total	NA	NA	--	--	--	--	--	110000
	Dissolved	NA	NA	--	--	--	--	--	110000
Chromium	Total	310	100	3.1	1U	1U	1U	1U	--
	Dissolved	310	100	--	--	--	3.4J	2.1	--
Iron	Total	NA	*26000	--	--	--	--	--	2300
	Dissolved	NA	*26000	--	--	--	--	--	120
Lead	Total	42	15	1.7	1UJ	1U	1.5	1U	3.9
	Dissolved	42	15	--	--	--	1U	1U	0.24J
Magnesium	Total	NA	NA	--	--	--	--	--	34000
	Dissolved	NA	NA	--	--	--	--	--	35000
Maganese	Total	NA	*880	--	--	--	--	--	70
	Dissolved	NA	*880	--	--	--	--	--	60
Mercury	Total	31	2	0.2 U	0.2U	0.2U	0.2U	0.2U	--
	Dissolved	31	2	--	--	--	--	--	--
Selenium	Total	510	50	2 U	2U	2U	2U	2UJ	--
	Dissolved	510	50	--	--	--	2UJ	2U	--
Silver	Total	510	*180	0.2 R	0.2UJ	0.2UJ	0.2U	0.2U	--
	Dissolved	510	*180	--	--	--	--	--	--
Sodium	Total	NA	NA	--	--	--	--	--	27000
	Dissolved	NA	NA	--	--	--	--	--	28000
pH				7.24	7.07	7.07	6.87	6.98	7.12
Dissolved Oxygen (ppm)				2.78	0.43	0.5	0.63	0.61	3.8
Specific Conductivity (mS)				637	725	0.768	0.798	0.827	0.68
Temperature (°C)				17.1	12	15.29	12.38	15.07	5.35
Oxidation/Reduction Potential (mv)				-127	-53	151	127	44	140
Turbidity (NTU)				33	8.1	24.1	8.3	54.4	41.8

* No MCL exists for iron, manganese, or silver. Value shown represents USEPA Regional tap water screening level
-- The sample was not analyzed for parameter
Qualifiers: U - not detected; J - estimated; R - rejected; UJ - not detected, estimated reporting limit
Indicates result over MCL (for arsenic, antimony, barium, cadmium, chromium, mercury, or selenium) or IDEM Industrial Default Risk Criteria for lead.

The results summarized are from groundwater sampling events performed by AGC following the RCRA Facility Work Plan.

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SUMMARY OF INORGAN... ROUNDWATER RESULTS

Well MW-5

Refined Metals Corporation

Beech Grove, Indiana

Parameter		IDEM Industrial Default RISC Criteria (µg/L)	MCL (µg/L)	Sampling Events 9/22/1999	12/14/1999	9/24/2001	12/11/2001	10/26/2003	4/24/2005	1/24/2007
Antimony	Total	41	6	10 U	10 U	10 U	10 U	10 U	1 U	1 U
	Dissolved	41	6	--	--	--	10 U	10 U	1 U	1 U
Arsenic	Total	10	10	8.4	10	7.6	5.4	8.8	3.2	4.3
	Dissolved	10	10	--	--	--	3.7 J	2.4	1.2	2.3
Barium	Total	20,000	2,000	149	162	170	150	159	177	--
	Dissolved	20,000	2,000	--	--	--	170	154	179	--
Cadmium	Total	51	5	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	--
	Dissolved	51	5	--	--	--	0.2 U	0.2 U	0.2 U	--
Calcium	Total	NA	NA	--	--	--	--	--	--	110,000
	Dissolved	NA	NA	--	--	--	--	--	--	110,000
Chromium	Total	310	100	1.5	1.9	1 U	1 U	1.1	1 U	--
	Dissolved	310	100	--	--	--	4 J	2.2	1.2	--
Iron	Total	NA	*26000	--	--	--	--	--	--	1,000
	Dissolved	NA	*26000	--	--	--	--	--	--	540
Lead	Total	42	15	1 U	1 UJ	2	2.1	2.1	9.1	4.3
	Dissolved	42	15	--	--	--	1 U	1 U	2.5	1 U
Magnesium	Total	NA	NA	--	--	--	--	--	--	38,000
	Dissolved	NA	NA	--	--	--	--	--	--	38,000
Maganese	Total	NA	*880	--	--	--	--	--	--	230
	Dissolved	NA	*880	--	--	--	--	--	--	210
Mercury	Total	31	2	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	--
	Dissolved	31	2	--	--	--	--	--	0.2 U	--
Selenium	Total	510	50	2 U	2.9	2 U	2 U	2 UJ	2 U	--
	Dissolved	510	50	--	--	--	2 UJ	2 U	2 U	--
Silver	Total	510	*180	0.2 R	0.2 UJ	0.2 UJ	0.2 U	0.2 U	0.2 UJ	--
	Dissolved	510	*180	--	--	--	--	--	0.2 UJ	--
Sodium	Total	NA	NA	--	--	--	--	--	--	29,000
	Dissolved	NA	NA	--	--	--	--	--	--	29,000
pH				7.47	7.14	7.14	6.92	7.08	7.95	7.13
Dissolved Oxygen (ppm)				3.05	0.29	0.43	0.43	0.62	0.51	1.21
Specific Conductivity (mS)				723	748	0.765	0.827	0.793	0.481	0.788
Temperature (°C)				18.2	13	16.54	12.81	12.3	10.66	5.65
Oxidation/Reduction Potential (mv)				-85	-43	90	51	107	215	62
Turbidity (NTU)				11.6	27.9	14.5	11.4	19.9	6.7	66.2

* No MCL exists for iron, manganese, or silver. Value shown represents USEPA Regional tap water screening level

-- The sample was not analyzed for parameter

Qualifiers: U - not detected; J - estimated; R - rejected; UJ - not detected, estimated reporting limit

Indicates result over MCL (for arsenic, antimony, barium, cadmium, chromium, mercury, or selenium) or IDEM Industrial Default Risk Criteria for lead.

The results summarized are from groundwater sampling events performed by AGC following the RCRA Facility Work Plan.

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F

SUMMARY OF INORGANIC GROUNDWATER RESULTS
Well MW-6S/6SR*
Refined Metals Corporation
Beech Grove, Indiana

Parameter		IDEM Industrial Default RISC Criteria (µg/L)	MCL (µg/L)	Sampling Events						
				9/23/1999	12/15/1999	9/24/2001	12/11/2001	10/26/2003	4/24/2005	1/24/2007
Antimony	Total	41	6	10 U	10 U	10 U	10 U	10 U	1 U	1 U
	Dissolved	41	6	10 U	10 U	--	10 U	10 U	1 U	1 U
Arsenic	Total	10	10	8.8 J	3.1	1.9	2.2	7.6	1 U	1.9
	Dissolved	10	10	1.7	1.6	--	1.4 J	1.2	1.5	0.885
Barium	Total	20,000	2,000	218	82	92	79	228	70	--
	Dissolved	20,000	2,000	39	36	--	89	117	90	--
Cadmium	Total	51	5	0.2	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	--
	Dissolved	51	5	0.2 U	0.2 U	--	0.2 U	0.2 U	0.2 U	--
Calcium	Total	NA	NA	--	--	--	--	--	--	84000
	Dissolved	NA	NA	--	--	--	--	--	--	76000
Chromium	Total	310	100	26	7.5	1 U	1 U	4.5	1 U	--
	Dissolved	310	100	8.7	1 U	--	3.8 J	2.1	1.3	--
Iron	Total	NA	*26000	--	--	--	--	--	--	2600
	Dissolved	NA	*26000	--	--	--	--	--	--	670
Lead	Total	42	15	21	4.9 J	1 U	1.3	2.7	1 U	2.1
	Dissolved	42	15	1 U	1 UJ	--	1 U	1 U	1 U	1 U
Magnesium	Total	NA	NA	--	--	--	--	--	--	31000
	Dissolved	NA	NA	--	--	--	--	--	--	28000
Maganese	Total	NA	*880	--	--	--	--	--	--	99
	Dissolved	NA	*880	--	--	--	--	--	--	85
Mercury	Total	31	2	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	--
	Dissolved	31	2	0.2 U	0.2	--	--	--	0.2 U	--
Selenium	Total	510	50	4.9 J	2.1	2 U	2 U	2 UJ	2 U	--
	Dissolved	510	50	2.9 J	2 U	--	2 UJ	2 U	2 U	--
Silver	Total	510	*180	0.2 UJ	0.2 UJ	0.2 UJ	0.2 U	0.2 U	0.2 UJ	--
	Dissolved	510	*180	0.2 U	0.2 UJ	--	--	--	0.2 UJ	--
Sodium	Total	NA	NA	--	--	--	--	--	--	35000
	Dissolved	NA	NA	--	--	--	--	--	--	37000
pH				7.05	7.5	713	6.87	7.2	7.27	7.02
Dissolved Oxygen (ppm)				8.21	3.34	0.48	0.62	0.76	0.45	1.69
Specific Conductivity (mS)				1578	1333	0.842	0.9	0.878	0.471	0.752
Temperature (°C)				14.2	8.7	16.2	10.58	12.97	8.99	9.34
Oxidation/Reduction Potential (mv)				342	50	78	50	62	219	0.696
Turbidity (NTU)				169	358	11.9	7.9	115.6	35	47

* MW-6S reconstructed as MW-6SR between 12/15/1999 and 9/24/2001 sampling events
* No MCL exists for iron, manganese, or silver. Value shown represents USEPA Regional tap water screening level
-- The sample was not analyzed for parameter
Qualifiers: U - not detected; J - estimated; R - rejected; UJ - not detected, estimated reporting limit
Indicates result over MCL (for arsenic, antimony, barium, cadmium, chromium, mercury, or selenium) or IDEM Industrial Default Risk Criteria for lead.

The results summarized are from groundwater sampling events performed by AGC following the RCRA Facility Work Plan.

1. 1G

SUMMARY OF INORGANIC GROUNDWATER RESULTS

Well MW-7/ 7S

Refined Metals Corporation

Beech Grove, Indiana

Parameter		IDEM Industrial Default RISC Criteria (µg/L)	MCL (µg/L)	Sampling Events			
				9/22/2001	12/11/2001	10/27/2003	1/25/2007
Antimony	Total	41	6	10U	10U	10U	2.9
	Dissolved	41	6	–	10U	10U	1U
Arsenic	Total	10	10	25	26	22J	150
	Dissolved	10	10	–	30J	25	5.9
Barium	Total	20,000	2,000	21	25	17	–
	Dissolved	20,000	2,000	–	23	15	–
Cadmium	Total	51	5	0.2U	0.2U	0.2U	–
	Dissolved	51	5	–	0.2U	0.2U	–
Calcium	Total	NA	NA	–	–	–	470000
	Dissolved	NA	NA	–	–	–	480000
Chromium	Total	310	100	1U	2.8	1.9	–
	Dissolved	310	100	–	13J	7.4	–
Iron	Total	NA	*26000	–	–	–	30000
	Dissolved	NA	*26000	–	–	–	4100
Lead	Total	42	15	19	47	217	94
	Dissolved	42	15	–	2.5	1	1U
Magnesium	Total	NA	NA	–	–	–	290000
	Dissolved	NA	NA	–	–	–	280000
Manganese	Total	NA	*880	–	–	–	250
	Dissolved	NA	*880	–	–	–	220
Mercury	Total	31	2	0.2U	0.2U	.2U	–
	Dissolved	31	2	–	–	–	–
Selenium	Total	510	50	3.7J	5.7	2UJ	–
	Dissolved	510	50	–	6.5J	2U	–
Silver	Total	510	*180	0.2UJ	0.2U	.2U	–
	Dissolved	510	*180	–	–	–	–
Sodium	Total	NA	NA	–	–	–	310000
	Dissolved	NA	NA	–	–	–	300000
pH				6.59	6.41	6.46	6.79
Dissolved Oxygen (ppm)				0.5	0.79	0.54	2.6
Specific Conductivity (mS)				3.8	4.50	3.92	3.71
Temperature (°C)				20.73	13.78	15.03	8.43
Oxidation/Reduction Potential (mv)				6	48	47	28
Turbidity (NTU)				6.8	27	242	501

* No MCL exists for iron, manganese, or silver. Value shown represents USEPA Regional tap water screening level

– The sample was not analyzed for parameter

Qualifiers: U - not detected; J - estimated; R - rejected; UJ - not detected, estimated reporting limit

Indicates result over MCL (for arsenic, antimony, barium, cadmium, chromium, mercury, or selenium) or IDEM Industrial Default Risk Criteria for lead.

The results summarized are from groundwater sampling events performed by AGC following the RCRA Facility Work Plan.

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1. 1H

SUMMARY OF INORGANIC GROUNDWATER RESULTS
Well MW-8/ 8S
Refined Metals Corporation
Beech Grove, Indiana

Parameter		IDEM Industrial Default RISC Criteria (µg/L)	MCL (µg/L)	Sampling Events 9/22/2001	12/11/2001	10/28/2003	1/24/2007
Antimony	Total	41	6	14	10U	10U	5.7
	Dissolved	41	6	--	10U	10U	5
Arsenic	Total	10	10	5.1	[redacted]	[redacted]	3.2
	Dissolved	10	10	--	[redacted]	[redacted]	2
Barium	Total	20,000	2,000	133	123	89	--
	Dissolved	20,000	2,000	--	135	79	--
Cadmium	Total	51	5	0.8	0.40	0.2U	--
	Dissolved	51	5	--	0.30	0.2U	--
Calcium	Total	NA	NA	--	--	--	140,000
	Dissolved	NA	NA	--	--	--	140,000
Chromium	Total	310	100	1U	1U	1.1	--
	Dissolved	310	100	--	3.8	2.9	--
Iron	Total	NA	*26000	--	--	--	190
	Dissolved	NA	*26000	--	--	--	40
Lead	Total	42	15	21	23	[redacted]	21
	Dissolved	42	15		11.0	15	2.1
Magnesium	Total	NA	NA	--	--	--	66,000
	Dissolved	NA	NA	--	--	--	68,000
Manganese	Total	NA	*880	--	--	--	95
	Dissolved	NA	*880	--	--	--	27
Mercury	Total	31	2	.2U	0.2U	0.2U	--
	Dissolved	31	2	--	--	--	--
Selenium	Total	510	50	2U	2U	2UJ	--
	Dissolved	510	50	--	2UJ	2U	--
Silver	Total	510	*180	0.2UJ	.2U	0.2U	--
	Dissolved	510	*180	--	--	--	--
Sodium	Total	NA	NA	--	--	--	39,000
	Dissolved	NA	NA	--	--	--	38,000
pH				7.11	7.13	7.23	7.17
Dissolved Oxygen (ppm)				0.55	0.59	0.91	4.41
Specific Conductivity (mS)				0.919	1.02	1.028	1.176
Temperature (°C)				20.42	15.43	13.88	9.17
Oxidation/Reduction Potential (mv)				171	67	45	169
Turbidity (NTU)				3.9	5.3	6.9	15.3

* No MCL exists for iron, manganese, or silver. Value shown represents USEPA Regional tap water screening level
-- The sample was not analyzed for parameter
Qualifiers: U - not detected; J - estimated; R - rejected; UJ - not detected, estimated reporting limit
Indicates result over MCL (for arsenic, antimony, barium, cadmium, chromium, mercury, or selenium) or IDEM Industrial Default Risk Criteria for lead.

The results summarized are from groundwater sampling events performed by AGC following the RCRA Facility Work Plan.

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T 1I

SUMMARY OF INORGA OUNDWATER RESULTS

Well MW-9

Refined Metals Corporation

Beech Grove, Indiana

Parameter		IDEM Industrial Default RISC Criteria (µg/L)	MCL (µg/L)	Sampling Events 9/22/2001	12/10/2001	10/27/2003	4/24/2005	1/22/2007
Antimony	Total	41	6	10 U	10 U	10 U	1 U	1 U
	Dissolved	41	6	--	10 U	10 U	1 U	1 U
Arsenic	Total	10	10	7.7	4	4.2	2.1	1.6
	Dissolved	10	10	--	3.7 J	2.7	1 U	1
Barium	Total	20,000	2,000	137	68	43	39	--
	Dissolved	20,000	2,000	--	68	41	36	--
Cadmium	Total	51	5	0.2 U	0.2 U	0.2 U	0.2 U	--
	Dissolved	51	5	--	0.2 U	0.2 U	0.2 U	--
Calcium	Total	NA	NA	--	--	--	--	160,000
	Dissolved	NA	NA	--	--	--	--	160,000
Chromium	Total	310	100	1 U	2.2	1 U	1 U	--
	Dissolved	310	100	--	3.8 J	1.9	1 U	--
Iron	Total	NA	*26000	--	--	--	--	270
	Dissolved	NA	*26000	--	--	--	--	4.5
Lead	Total	42	15	1.6	1 U	1	2.2	0.43 J
	Dissolved	42	15	--	1 U	1 U	1 U	1 U
Mercury	Total	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	--
	Dissolved	NA	NA	--	--	--	0.2 U	--
Magnesium	Total	NA	*880	--	--	--	--	50,000
	Dissolved	NA	*880	--	--	--	--	49,000
Manganese	Total	31	2	--	--	--	--	37
	Dissolved	31	2	--	--	--	--	7.7
Selenium	Total	510	50	2 U	2 U	2 UJ	2 U	--
	Dissolved	510	50	--	2 UJ	2 U	2 U	--
Silver	Total	510	*180	0.2 UJ	0.2 U	0.2 U	0.2 UJ	--
	Dissolved	510	*180	--	--	--	0.2 UJ	--
Sodium	Total	NA	NA	--	--	--	--	14,000
	Dissolved	NA	NA	--	--	--	--	15,000
pH				7.22	7.02	6.97	8.17	7.12
Dissolved Oxygen (ppm)				4.88	1.11	0.7	2.09	5.12
Specific Conductivity (mS)				0.874	1.094	0.967	0.494	0.95
Temperature (°C)				16.55	11.74	13.52	7.11	8.01
Oxidation/Reduction Potential (mv)				202	68	56	218	195
Turbidity (NTU)				0.9	0.9	7.9	4.9	7.36

* No MCL exists for iron, manganese, or silver. Value shown represents USEPA Regional tap water screening level

-- The sample was not analyzed for parameter

Qualifiers: U - not detected; J - estimated; R - rejected; UJ - not detected, estimated reporting limit

Indicates result over MCL (for arsenic, antimony, barium, cadmium, chromium, mercury, or selenium) or IDEM Industrial Default Risk Criteria for lead.

1. .1J

SUMMARY OF INORGANIC GROUNDWATER RESULTS
Well MW-10
Refined Metals Corporation
Beech Grove, Indiana

Parameter		IDEM Industrial Default RISC Criteria (µg/L)	MCL (µg/L)	Sampling Events	
				10/28/2003	1/23/2007
Antimony	Total	41	6	10U	1U
	Dissolved	41	6	10U	1U
Arsenic	Total	10	10	[redacted]	[redacted]
	Dissolved	10	10	7.5	5.8
Barium	Total	20,000	2,000	71	--
	Dissolved	20,000	2,000	16.00	--
Cadmium	Total	51	5	0.2U	--
	Dissolved	51	5	0.2U	--
Calcium	Total	NA	NA	--	270,000
	Dissolved	NA	NA	--	360,000
Chromium	Total	310	100	1.6U	--
	Dissolved	310	100	5.2	--
Iron	Total	NA	*26000	--	17,000
	Dissolved	NA	*26000	--	11,000
Lead	Total	42	15	1U	2.1U
	Dissolved	42	15	1U	1U
Magnesium	Total	NA	NA	--	610,000
	Dissolved	NA	NA	--	590,000
Manganese	Total	NA	*880	--	340
	Dissolved	NA	*880	--	340
Mercury	Total	31	2	0.2U	--
	Dissolved	31	2	--	--
Selenium	Total	510	50	2UJ	--
	Dissolved	510	50	2.3	--
Silver	Total	510	*180	0.2U	--
	Dissolved	510	*180	--	--
Sodium	Total	NA	NA	--	1,000,000
	Dissolved	NA	NA	--	1,000,000
pH				6.73	6.99
Dissolved Oxygen (ppm)				0.74	1.87
Specific Conductivity (mS)				6.69	7.24
Temperature (°C)				10.23	7.91
Oxidation/Reduction Potential (mv)				68	-1
Turbidity (NTU)				15.8	179.0

* No MCL exists for iron, manganese, or silver. Value shown represents USEPA Regional tap water screening level
-- The sample was not analyzed for parameter
Qualifiers: U - not detected; J - estimated; R - rejected; UJ - not detected, estimated reporting limit
Indicates result over MCL (for arsenic, antimony, barium, cadmium, chromium, mercury, or selenium) or IDEM Industrial Default Risk Criteria for lead.
selenium or silver) or IDEM Residential Default Risk Criteria for arsenic or lead.

The results summarized are from groundwater sampling events performed by AGC following the RCRA Facility Work Plan.

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TABLE 1K
SUMMARY OF INORGANIC GROUNDWATER RESULTS
Well MW-11
Refined Metals Corporation
Beech Grove, Indiana

Parameter		IDEM Industrial Default RISC Criteria (µg/L)	MCL (µg/L)	Sampling Events	
				10/27/2003	1/25/2007
Antimony	Total	41	6	10U	1.20
	Dissolved	41	6	10U	1U
Arsenic	Total	10	10	7.1	4
	Dissolved	10	10	7.10	1
Barium	Total	20,000	2,000	167	--
	Dissolved	20,000	2,000	167	--
Cadmium	Total	51	5	0.2U	--
	Dissolved	51	5	0.2U	--
Calcium	Total	NA	NA	--	170,000
	Dissolved	NA	NA	--	170,000
Chromium	Total	310	100	1.1	--
	Dissolved	310	100	1U	--
Iron	Total	NA	*26000	--	960
	Dissolved	NA	*26000	--	28
Lead	Total	42	15	1U	3
	Dissolved	42	15	1U	0.99
Magnesium	Total	NA	NA	--	64,000
	Dissolved	NA	NA	--	67,000
Manganese	Total	NA	*880	--	260
	Dissolved	NA	*880	--	210
Mercury	Total	31	2	0.2U	--
	Dissolved	31	2	--	--
Selenium	Total	510	50	2UJ	--
	Dissolved	510	50	2U	--
Silver	Total	510	*180	0.2U	--
	Dissolved	510	*180	--	--
Sodium	Total	NA	NA	--	66,000
	Dissolved	NA	NA	--	71,000
pH				7.06	7.15
Dissolved Oxygen (ppm)				0.74	3.19
Specific Conductivity (mS)				1.116	1.416
Temperature (°C)				11.17	10.77
Oxidation/Reduction Potential (mv)				41	136
Turbidity (NTU)				3.1	19.8

* No MCL exists for iron, manganese, or silver. Value shown represents USEPA Regional tap water screening level
-- The sample was not analyzed for parameter
Qualifiers: U - not detected; J - estimated; R - rejected; UJ - not detected, estimated reporting limit
Indicates result over MCL (for arsenic, antimony, barium, cadmium, chromium, mercury, or selenium) or IDEM Industrial Default Risk Criteria for lead.

The results summarized are from groundwater sampling events performed by AGC following the RCRA Facility Work Plan.

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TABLE 1L
SUMMARY OF INORGANIC GROUNDWATER RESULTS
Well MW-12
Refined Metals Corporation
Beech Grove, Indiana

Parameter		IDEM Industrial Default RISC Criteria (µg/L)	MCL (µg/L)	Sampling Events	
				4/24/2005	1/23/2007
Antimony	Total	41	6	1 U	1 U
	Dissolved	41	6	1 U	1 U
Arsenic	Total	10	10	1 U	1.1
	Dissolved	10	10	1 U	1 U
Calcium	Total	20,000	2,000	--	90,000
	Dissolved	20,000	2,000	--	93,000
Barium	Total	51	5	86	--
	Dissolved	51	5	86	--
Cadmium	Total	NA	NA	0.2 U	--
	Dissolved	NA	NA	0.2 U	--
Iron	Total	310	100	--	410
	Dissolved	310	100	--	55
Chromium	Total	NA	*26000	1 U	--
	Dissolved	NA	*26000	1 U	--
Magnesium	Total	42	15	--	27,000
	Dissolved	42	15	--	28,000
Manganese	Total	NA	NA	--	67
	Dissolved	NA	NA	--	73
Lead	Total	NA	*880	1 U	1.1
	Dissolved	NA	*880	1 U	1 U
Mercury	Total	31	2	0.2 U	--
	Dissolved	31	2	0.2 U	--
Selenium	Total	510	50	2 U	--
	Dissolved	510	50	2 U	--
Silver	Total	510	*180	0.2 UJ	--
	Dissolved	510	*180	0.2 UJ	--
Sodium	Total	NA	NA	--	8,300
	Dissolved	NA	NA	--	9,000
pH				7.21	7.05
Dissolved Oxygen (ppm)				0.32	3.36
Specific Conductivity (mS)				0.417	0.539
Temperature (°C)				9.24	8.56
Oxidation/Reduction Potential (mv)				232	111
Turbidity (NTU)				7.9	10.96

* No MCL exists for iron, manganese, or silver. Value shown represents USEPA Regional tap water screening level
-- The sample was not analyzed for parameter
Qualifiers: U - not detected; J - estimated; R - rejected; UJ - not detected, estimated reporting limit
Indicates result over MCL (for arsenic, antimony, barium, cadmium, chromium, mercury, or selenium) or IDEM Industrial Default Risk Criteria for lead.

The results summarized are from groundwater sampling events performed by AGC following the RCRA Facility Work Plan.

FIGURES

FIGURES

REF. U.S.G.S. 7 1/2 MINUTE
BEECH GROVE, IND
QUADRANGLE MAP

2000 0 2000 4000

SCALE IN FEET

CORRECTIVE MEASURES DESIGN
REFINED METALS CORPORATION

BEECH GROVE, INDIANA

Scale: 1"=2000'	SITE LOCATION MAP
Originated By: K.M.S.	
Drawn By: P.S.G.	
Checked By: S.W.K.	Advanced GeoServices Corp. 1055 Andrew Drive, Suite A West Chester, Pennsylvania 19380 (610) 840-9100 FAX: (610) 840-9199
Project Mgr: P.G.S.	
Dwg No. 2003-1046-05-02	
Issued:	Project No. 2003-1046-05 — FIGURE: 1

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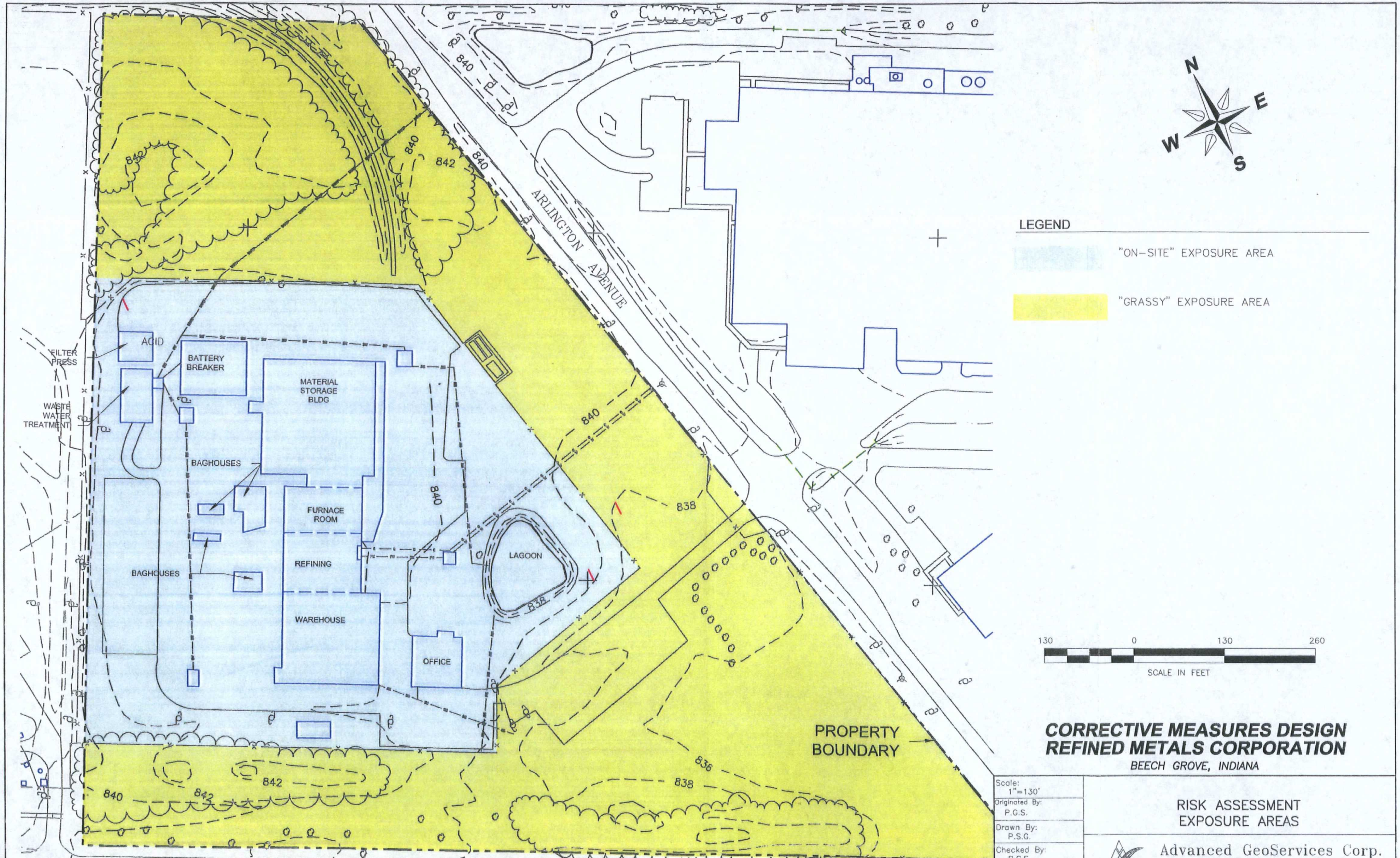
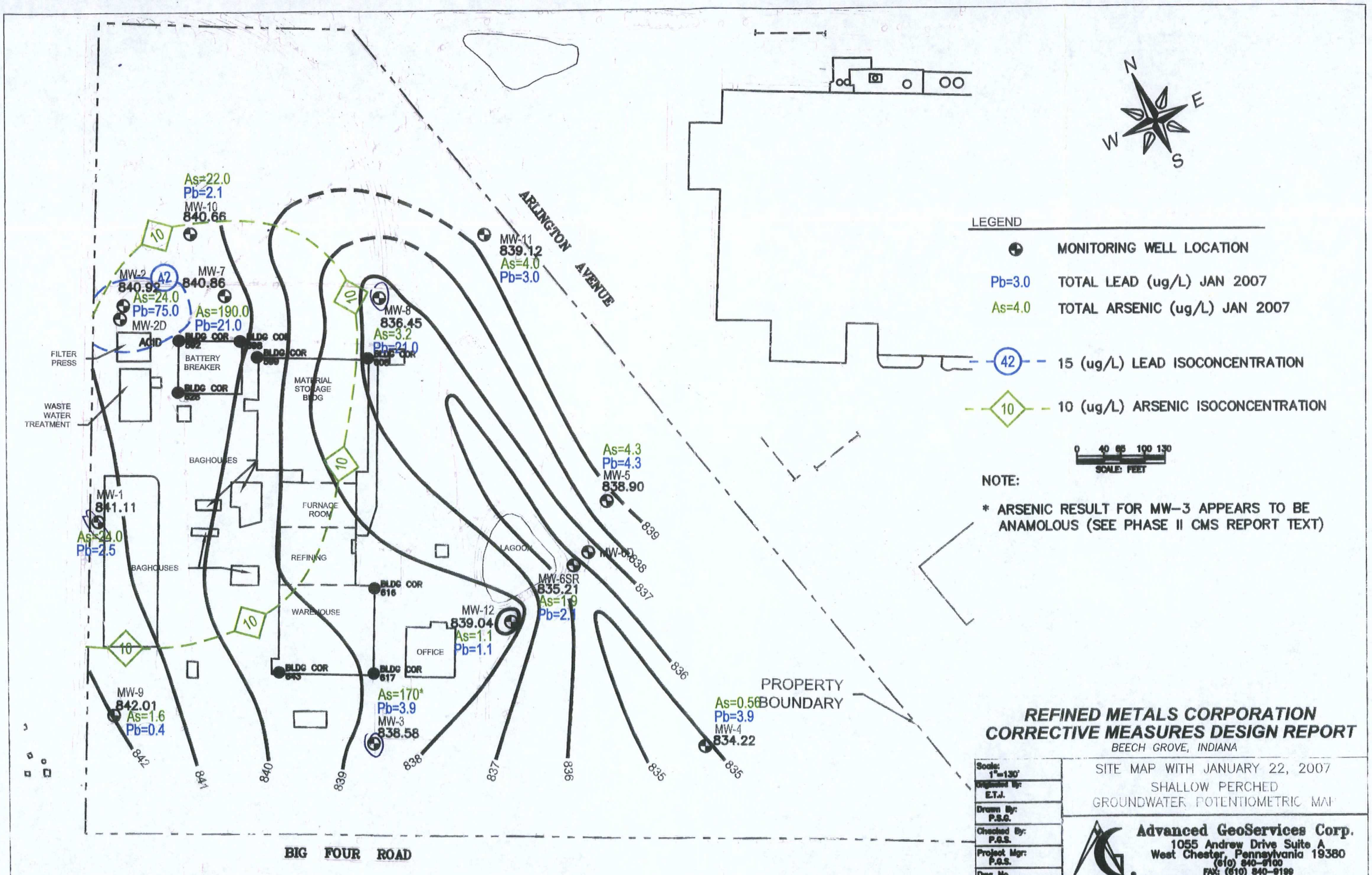


CORRECTIVE MEASURES DESIGN
REFINED METALS CORPORATION
BEECH GROVE, INDIANA

Scale: 1"=130'	RISK ASSESSMENT EXPOSURE AREAS
Originated By: P.G.S.	
Drawn By: P.S.G.	
Checked By: P.G.S.	Advanced GeoServices Corp. 1055 Andrew Drive Suite A West Chester, Pennsylvania 19380 (610) 840-9100 FAX: (610) 840-9199
Project Mgr: P.G.S.	
Dwg No. 2003-1046-05-10	Project No. 2003-1046-05
Issued: APR 12 2010	FIGURE: 2

J:\Refined Metals\Drawings\2003-1046-05\2003-1046-05-10.dwg



REFINED METALS CORPORATION
CORRECTIVE MEASURES DESIGN REPORT

BEECH GROVE, INDIANA

SITE MAP WITH JANUARY 22, 2007 SHALLOW PERCHED GROUNDWATER POTENTIOMETRIC MAP

Scale: 1"=130'	
Originated By: E.T.J.	
Drawn By: P.S.G.	
Checked By: P.G.S.	
Project Mgr: P.G.S.	
Dwg No. 2003-1046-12-001	
Issued: APR 12 20[illegible]	Project No. 2003-1046-12

Advanced GeoServices Corp.
1055 Andrew Drive Suite A
West Chester, Pennsylvania 19380
(610) 840-9100
FAX: (610) 840-9199

FIGURE: 3

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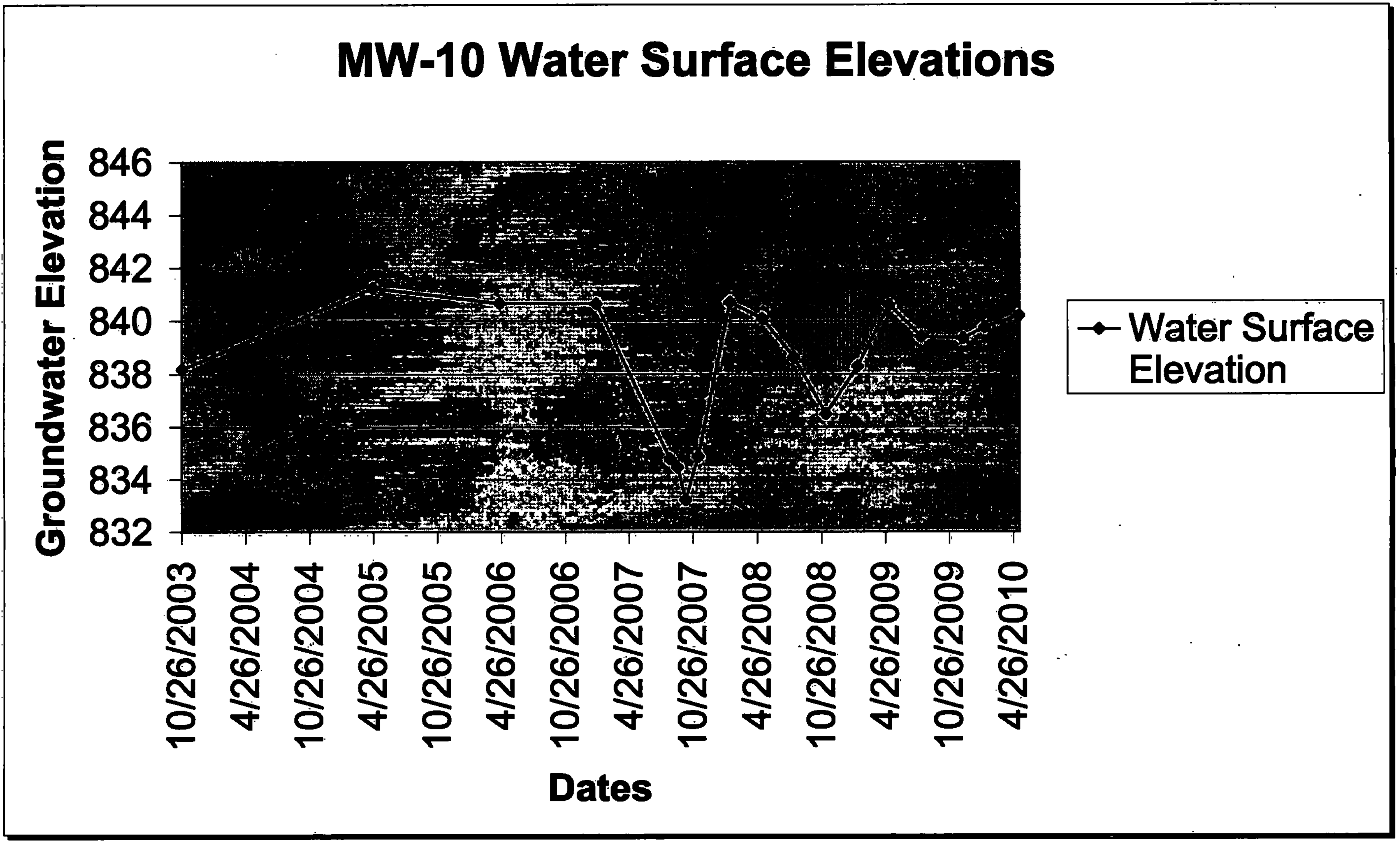
FIGURE 4
REFINED METALS
BEECH GROVE, IN
CORRECTIVE MEASURES DESIGN



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ATTACHMENT A

Design Drawings
(Provided Separately)

ATTACHMENT A

Design Drawings
(Provided Separately)

DESIGN DRAWINGS

FINAL CORRECTIVE MEASURES DESIGN

REFINED METALS CORPORATION
BEECH GROVE, INDIANA

SHEET No.	TITLE
1	EXISTING CONDITIONS SITE PLAN
2	SOIL AND SEDIMENT SAMPLE LOCATION PLAN
3	SOIL AND SEDIMENT SAMPLE RESULTS
4	SITE PREPARATION AND EROSION CONTROL PLAN
5	CONTAINMENT CELL CONSTRUCTION, FILLING AND CAPPING PLAN
6	HAZARDOUS WASTE MANAGEMENT UNIT CLOSURE PLAN
7	SOIL AND SEDIMENT EXCAVATION PLAN (EAST)
8	SOIL AND SEDIMENT EXCAVATION PLAN (WEST)
9	RESTORATION AND FINAL EROSION AND SEDIMENT CONTROL PLAN (EAST)
10	RESTORATION AND FINAL EROSION AND SEDIMENT CONTROL PLAN (WEST)
11	CONSTRUCTION DETAILS
12	CONSTRUCTION DETAILS

NOTE:

THESE DESIGN DRAWINGS ARE CONSIDERED DRAFT AND ARE NOT SUITABLE FOR CONSTRUCTION. THE DESIGN DRAWINGS WILL BE FINALIZED BASED ON REGULATORY COMMENTS AT WHICH TIME THEY WILL BE SIGNED AND SEALED BY THE PROFESSIONAL ENGINEER AND WILL BE CONSIDERED SUITABLE FOR CONSTRUCTION.

ADVANCED GeoServices
Engineering for the Environment. Planning for People.™
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WEST CHESTER, PA 19380
tel 610.840.9100
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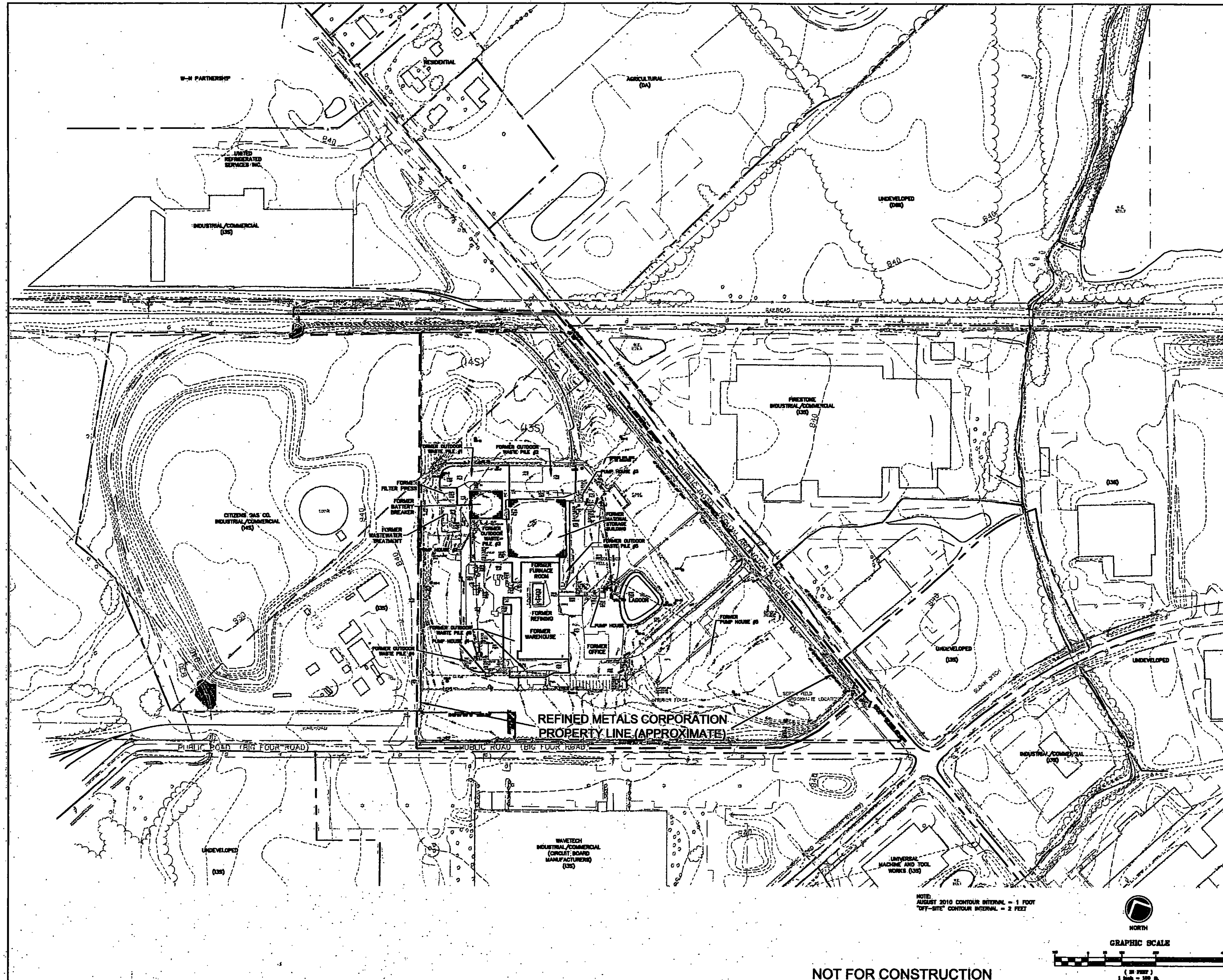
www.advancedgeoservices.com

OCT 06 2010

FINAL DESIGN.Pdf



NOTES:

1. TOPOGRAPHIC SURVEY WITHIN REFINED METALS PROPERTY OBTAINED FROM FIELD SURVEY PERFORMED BY THE SCHNEIDER CORPORATION AUGUST, 2010. ORIGINATING BENCHMARK INDIANA DEPARTMENT OF TRANSPORTATION BRONZE DISC STAMPED "MAR G-354" ELEVATION 882.48 (NGVD 29).

2. TOPOGRAPHIC INFORMATION OUTSIDE OF REFINED METALS PROPERTY OBTAINED FROM IMAGIS CITY OF INDIANAPOLIS BASED ON NGVD 29.

3. BUILDINGS ON THE REFINED METALS PROPERTY HAVE BEEN DEMOLISHED, EXCEPT PUMP HOUSES #1 THROUGH #4.

ADVANCED GeoServices

Engineering for the Environment. Planning for People.™

REFINED METALS CORPORATION
BEECH GROVE, INDIANA

CORRECTIVE MEASURES DESIGN
FINAL DESIGN

EXISTING CONDITIONS SITE PLAN

1

Scale	1"=100'
	J.W.D.
	P.S.G.
	J.W.D.
	P.G.S.
	2003-1046
	1 OF 12

OCT 06 2010

RCRA Facility Investigation Sample Results

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Closure Investigation Sample Results

[illegible]

[illegible]

[illegible]

[illegible]

DATE	REVISION
9-14-10	REPLACED [illegible] MAP AND RESPONSE TO COMMENTS
10-6-10	REVISED TO FINAL DESIGN

LEGEND

Q	Qualifier
RL	Reporting Limit
J	Estimated
U	Not Detected
R	Rejected

RCRA FACILITY INVESTIGATION

RSB	RCRA Soil Boring
CG	Citizens Gas Soil
R2BG	Phase II RFI Background Soil
R2SB	Phase II RFI Soil Boring
CG-SED	Citizens Gas Sediment
RSED	RCRA Sediment
R2SED	Phase II RFI Sediment

CLOSURE INVESTIGATION

CSB	Closure Soil Boring
RSB	RCRA Soil Boring (within HWMU)
CSED	Closure Lagoon Sediment
CFD	Closure Floor Dust from Material Storage Building

NOTES:

1. RESULTS REPORTED IN mg/kg
2. SAMPLES DESIGNATED WITH AN "A" IMMEDIATELY AFTER THE BORING NUMBER WERE CO-LOCATED WITH THE INITIAL BORING. ADDITIONAL (DEEPER) SAMPLING PERFORMED IN 2007 WERE CONTINUATIONS OF THE INITIAL BORING.
3. RCRA SOIL BORING (RSB) SAMPLE RESULTS ARE INCLUDED IN CLOSURE INVESTIGATION RESULTS TABLES BECAUSE THEY ARE LOCATED WITHIN THE HAZARDOUS WASTE MANAGEMENT UNITS (HWMU).

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1055 ANDREW DRIVE, SUITE A
WEST CHESTER, PENNSYLVANIA 19380

REFINED METALS CORPORATION
BEECH GROVE, INDIANA

CORRECTIVE MEASURES DESIGN
FINAL DESIGN

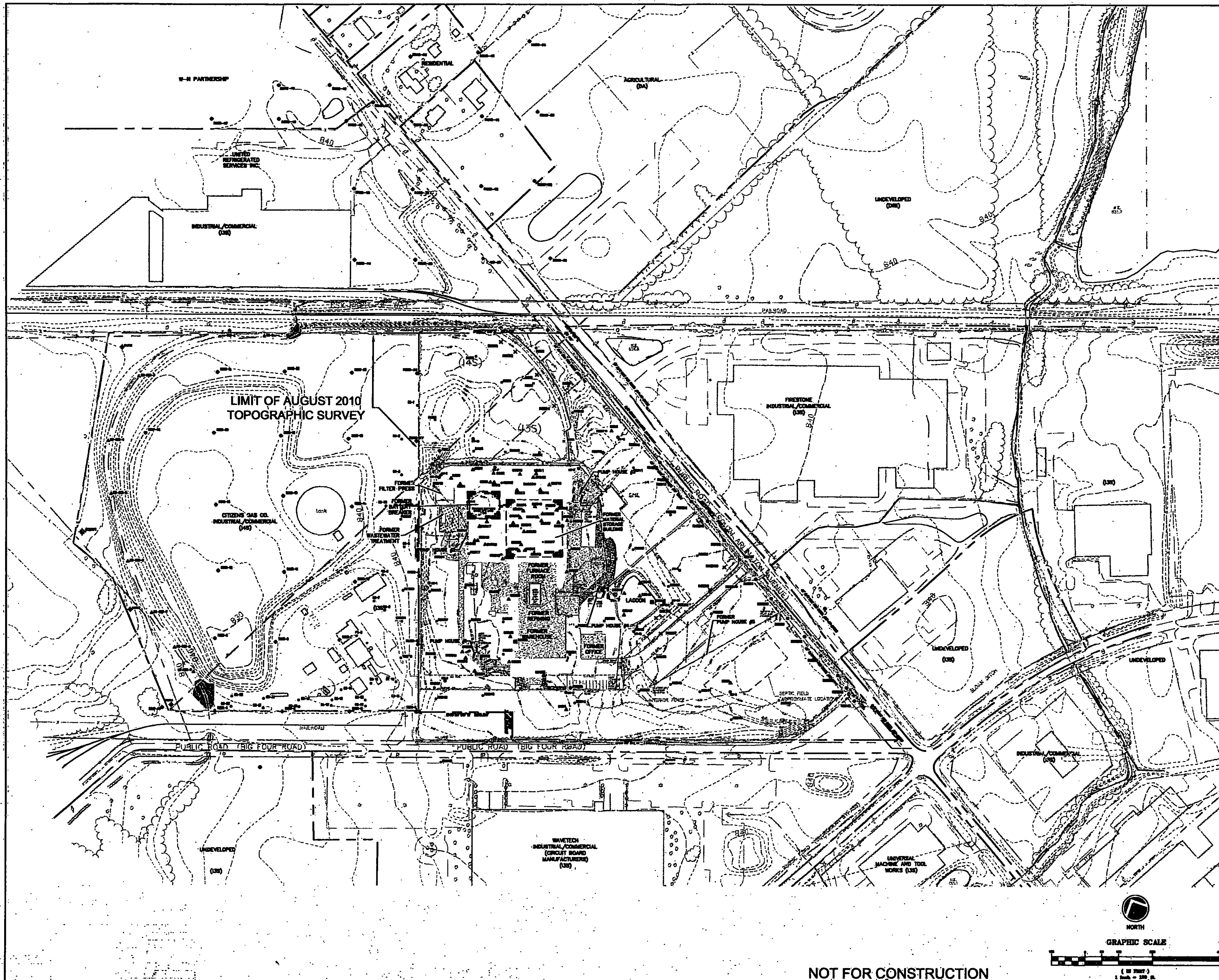
SOIL AND SEDIMENT SAMPLE RESULTS

3

Scale	N.T.S.
Designed by	J.W.D.
Drawn by	P.S.G.
Checked by	J.W.D.
Project Mgr.	P.G.S.
Project No.	2003-1049
Sheet No.	3 OF 12
Issued	

OCT 06 2010

NOT FOR CONSTRUCTION



NOT FOR CONSTRUCTION

LEGEND

- Existing Contour
- Existing Building
- Former Building Footprint
- Existing Edge of Paving
- Existing Right of Way
- Existing Tree Line
- Existing Wetland Limit Line
- Existing Flood Plain Limit Line
- Existing Lot Line
- Property Line (Approximate)
- Existing Sanitary Sewer
- Existing Stormwater Line
- Existing Water Line
- Existing Gas Line
- Existing Utility Pole
- Existing Fence Line
- Monitoring Well
- Approximate Soil Sample Location
- Soil Sample Location/Designation Surveyed by the Schneider Corp., Indianapolis, Indiana
- Soil Sample Location/Designation Surveyed by the Schneider Corp., Indianapolis, Indiana
- Phase II RFI Soil Sampling
- Sediment Sample Location. S. Arlington Ave. Drainage Ditch
- Sediment Sample Location. S. Arlington Ave. Drainage Ditch
- Sediment Sample Location in Grassy Area Swales
- RCRA Hazardous Waste Management Unit (HWMU)

NOTES:

1. TOPOGRAPHIC SURVEY WITHIN REFINED METALS PROPERTY OBTAINED FROM FIELD SURVEY PERFORMED BY THE SCHNEIDER CORPORATION AUGUST, 2010. ORIGINATING BENCHMARK INDIANA DEPARTMENT OF TRANSPORTATION BRONZE DISC STAMPED "MAR 0-354" ELEVATION 882.49 (NGVD 29).

2. TOPOGRAPHIC INFORMATION OUTSIDE OF REFINED METALS PROPERTY OBTAINED FROM IMAGIS CITY OF INDIANAPOLIS BASED ON NGVD 29.

3. BUILDINGS ON THE REFINED METALS PROPERTY HAVE BEEN DEMOLISHED, EXCEPT PUMP HOUSES #1 THROUGH #4.

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REFINED METALS CORPORATION
BEECH GROVE, INDIANA

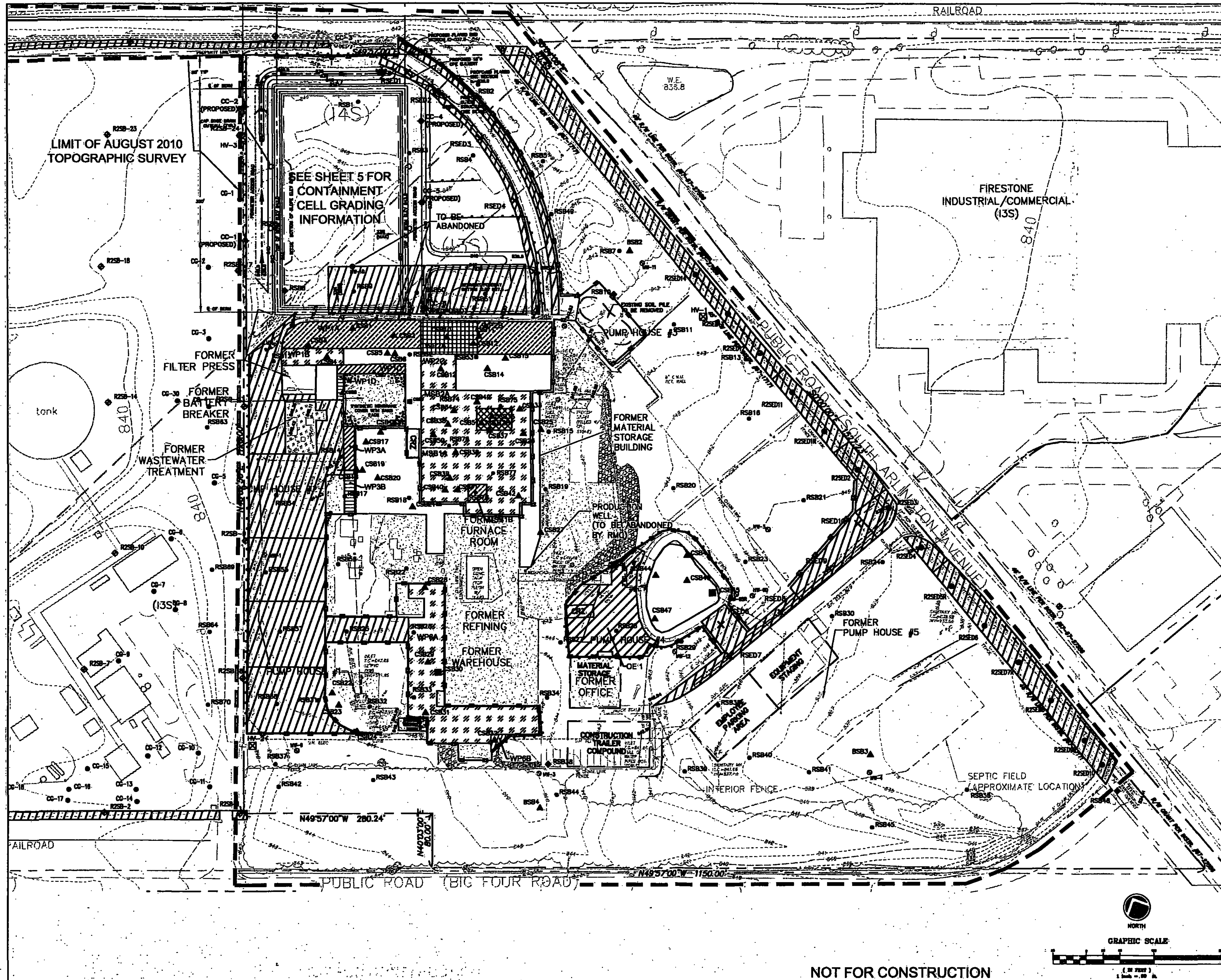
CORRECTIVE MEASURES DESIGN
FINAL DESIGN

SOIL AND SEDIMENT
SAMPLE LOCATION PLAN

2

Scale	1"=100'
Designed By	J.W.D.
Drawn By	P.S.G.
Checked By	J.W.D.
Project Mgr.	P.G.S.
Project No.	2003-1046
Sheet No.	2 OF 12

OCT 06 2010



DATE:	REVISION
9-14-10	REPLACED BASE MAP AND RESPONSE TO COMMENTS
10-6-10	REVISED TO FINAL DESIGN

LEGEND

- Existing Contour
- Existing Building
- Former Building Footprint
- Existing Edge of Paving
- Existing Right of Way
- Existing Tree Line
- Existing Wetland Limit Line
- Existing Flood Plain Limit Line
- Existing Lot Line
- Property Line (Approximate)
- Existing Sanitary Sewer
- Existing Stormwater Line w/ In
- Existing Water Line
- Existing Gas Line
- Existing Electric Line
- Existing Utility Pole
- Existing Fence Line
- Approximate Zoning Boundary
- (I3S) Medium Industrial Suburban District
- (I4S) Heavy Industrial Suburban District
- CC-1 (PROPOSED) Containment Cell Groundwater Monitoring Well (To be installed prior to start of CM construction by RMC)
- HV-3 Proposed High Volume Sampler
- RCRA Hazardous Waste Management Unit (HWMU)
- MW-11 Monitoring Well
- Remnant Building Floor Area Covered with Rubble and Geomembrane
- Proposed Silt Fence
- Proposed Excluding Zone Fence
- Proposed Combined Silt Fence & Excluding Zone Fence
- CRZ Proposed Containment Reduction Zone

NOTES:

1. TOPOGRAPHIC SURVEY WITHIN REFINED METALS PROPERTY OBTAINED FROM FIELD SURVEY PERFORMED BY THE SCHNEIDER CORPORATION AUGUST, 2010. ORIGINATING BENCHMARK INDIANA DEPARTMENT OF TRANSPORTATION BRONZE DISC STAMPED "MAR C-354" ELEVATION 882.49 (NGVD 29).

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3. BUILDINGS ON THE REFINED METALS PROPERTY HAVE BEEN DEMOLISHED, EXCEPT PUMP HOUSES #1 THROUGH #4.

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1055 ANDREW DRIVE, SUITE A
WEST CHESTER, PENNSYLVANIA 19380

REFINED METALS CORPORATION
BEECH GROVE, INDIANA

CORRECTIVE MEASURES DESIGN
FINAL DESIGN

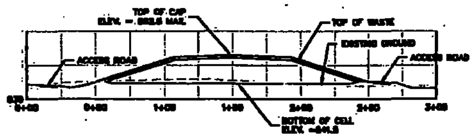
SITE PREPARATION AND
EROSION CONTROL PLAN

4

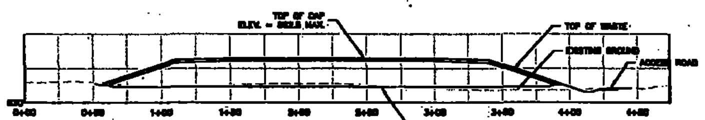
Scale	1"=50'
Designed By	J.W.D.
Drawn By	P.S.G.
Checked By	J.W.D.
Project Mgr	P.G.S.
Project No.	2003-1046
Sheet No.	4 OF 12

OCT 06 2010

DATE	REVISION
9-14-10	REPLACED BASE MAP AND RESPONSE TO COMMENTS
10-6-10	REVISED TO FINAL DESIGN



SECTION A – A'
1" = 50' H

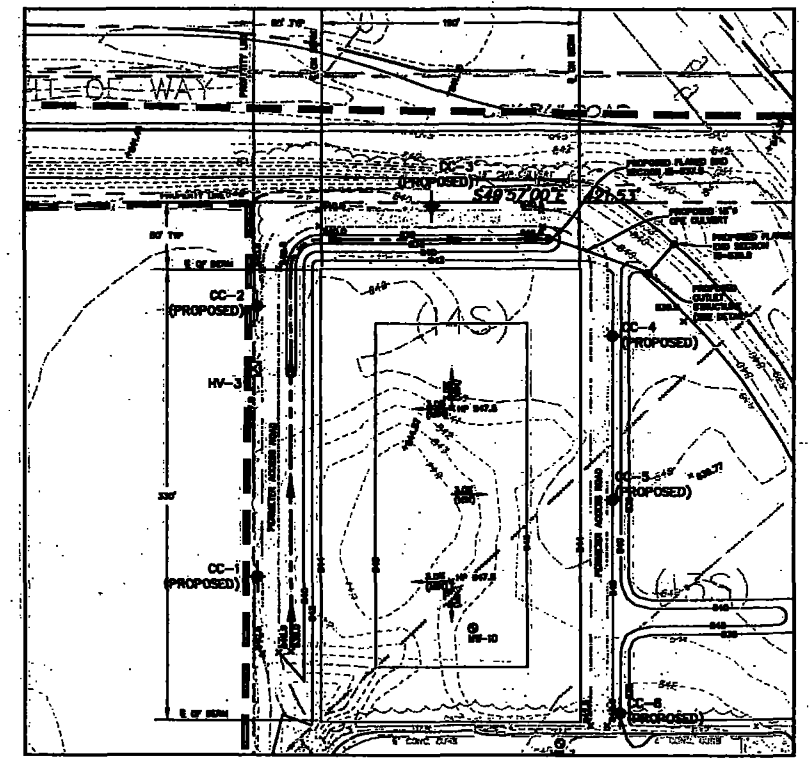


SECTION B – B'
1" = 50' H

CONTAINMENT CELL WASTE CAPACITY

ELEVATION	AREA	DIFF DEPTH (FT)	VOLUME (CF)	CUM VOLUME (CF)	CUM VOLUME (CY)
841.5	54,148				
		1	27,441	27,441	1,016
842	55,616				
		1	57,110	84,551	3,132
843	58,604				
		1	57,110	141,661	5,247
844	55,616				
		2	104,884	246,525	9,131
846	49,248				
		2	93,048	339,573	12,577
848	43,800				
		2	82,440	422,013	15,630
850	38,640				
		2	72,408	494,421	18,312
852	33,768				
		2	62,952	557,373	20,643
854	29,184				
		2	58,368	615,741	22,805
856	24,888				
		2	45,768	661,509	24,500
858	20,880				
		1	19,932	681,441	25,239
859	18,984				
		1	11,092	692,533	25,648
860	3,200				
		1	800	693,333	25,679
860.5	0				

TOTAL CELL CAPACITY 25,679 CY AT MAXIMUM GRADING
ESTABLISHED MINIMUM VOLUMN OF FILLS = 18,000 CU.YD. (EXCLUDING CITIZEAS GAS)
EXCESS AIR SPACE = 7,700 CU.YD. (APPROX. 40%)



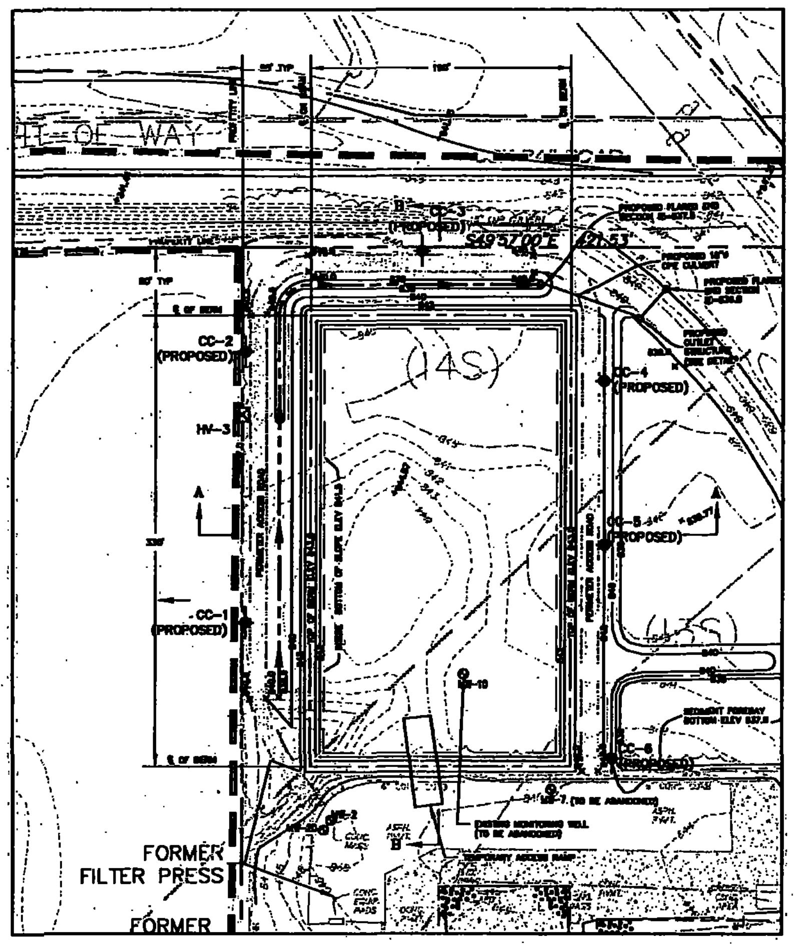
TOP OF CAP (MINIMUM SLOPE)
1" = 50'

LEGEND

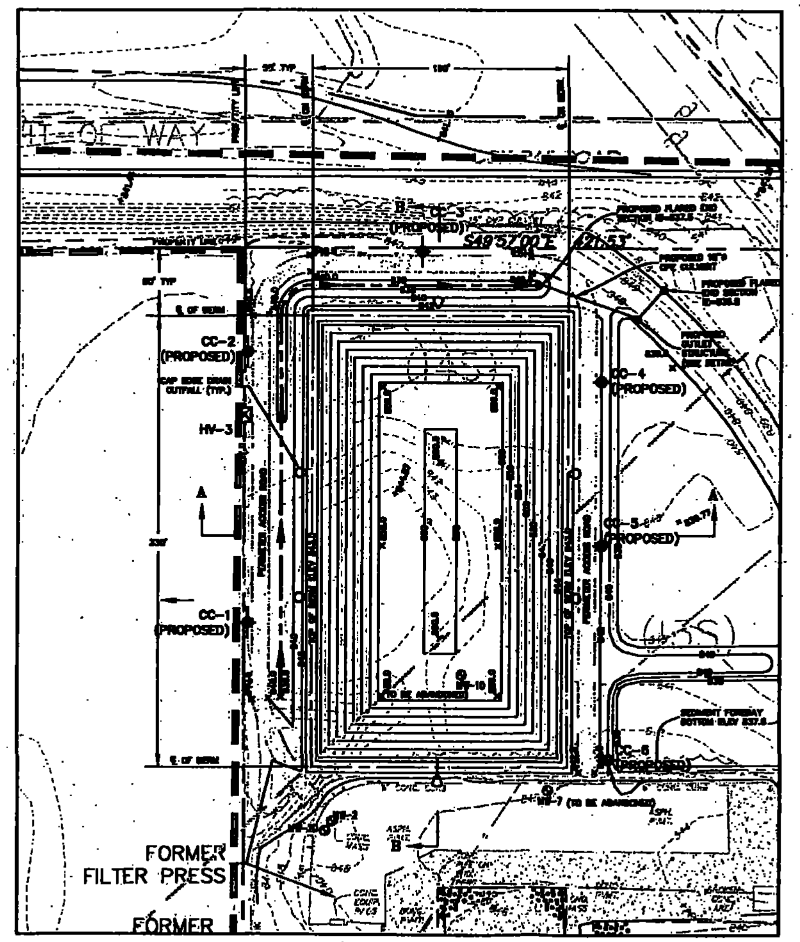
- Existing Contour
- Existing Building
- Former Building Footprint
- Existing Edge of Paving
- Existing Right of Way
- Existing Tree Line
- Existing Wetland Limit Line
- Existing Flood Plain Limit Line
- Existing Lot Line
- Property Line (Approximate)
- Existing Sanitary Sewer
- Existing Stormwater Line w/ Inlet
- Existing Water Line
- Existing Gas Line
- Existing Electric Line
- Existing Utility Pole
- Existing Fence Line

MW-11 Monitoring Well

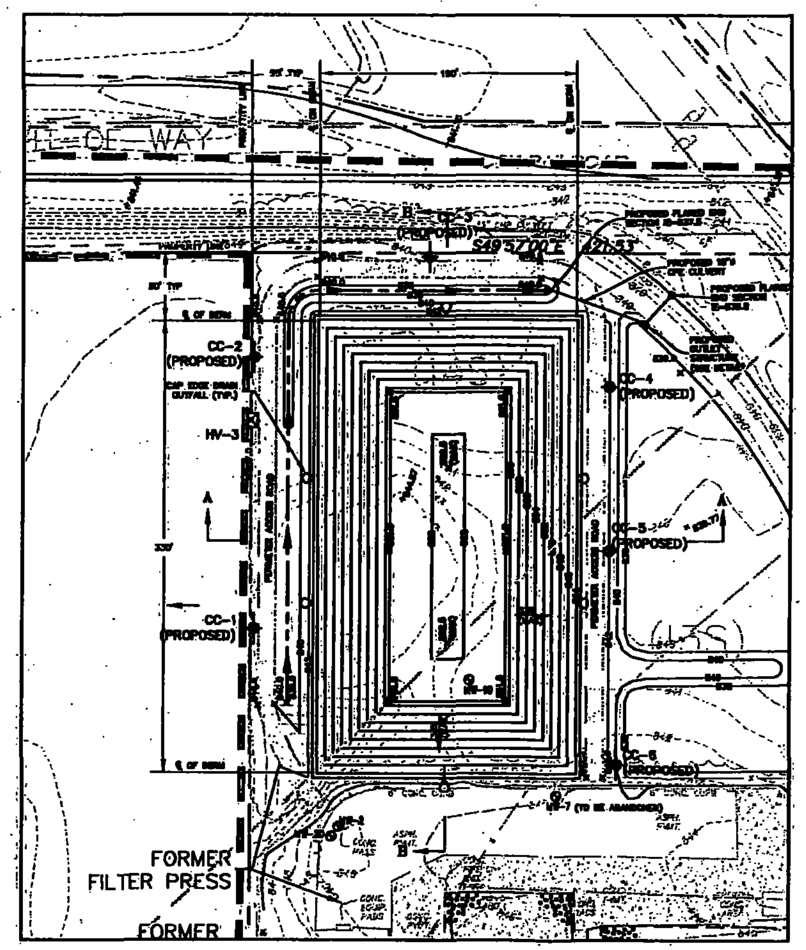
CC-1 (PROPOSED) Containment Cell Groundwater Monitoring Well (To be installed prior to start of CM construction by RMC)



BASE GRADING
1" = 50'



TOP OF WASTE
1" = 50'



TOP OF CAP (MAXIMUM SLOPE)
1" = 50'

NOTES:

1. TOPOGRAPHIC SURVEY WITHIN REFINED METALS PROPERTY OBTAINED FROM FIELD SURVEY PERFORMED BY THE SCHNEIDER CORPORATION AUGUST, 2010. ORIGINATING BENCHMARK INDIANA DEPARTMENT OF TRANSPORTATION BRONZE DISC STAMPED "MAR G-354" ELEVATION 882.49 (NGVD 29).

2. TOPOGRAPHIC INFORMATION OUTSIDE OF REFINED METALS PROPERTY OBTAINED FROM IMAGIS CITY OF INDIANAPOLIS BASED ON NGVD 29.

3. BUILDINGS ON THE REFINED METALS PROPERTY HAVE BEEN DEMOLISHED, EXCEPT PUMP HOUSES #1 THROUGH #4.

4. CONTRACTORS SURVEYOR MUST FIELD LOCATE RMC PROPERTY LINE AND PERFORM FIELD STAKEOUT RELATIVE TO PROPERTY LINE.

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REFINED METALS CORPORATION
BEECH GROVE, INDIANA

CORRECTIVE MEASURES DESIGN
FINAL DESIGN

CONTAINMENT CELL CONSTRUCTION, FILLING AND CAPPING PLAN

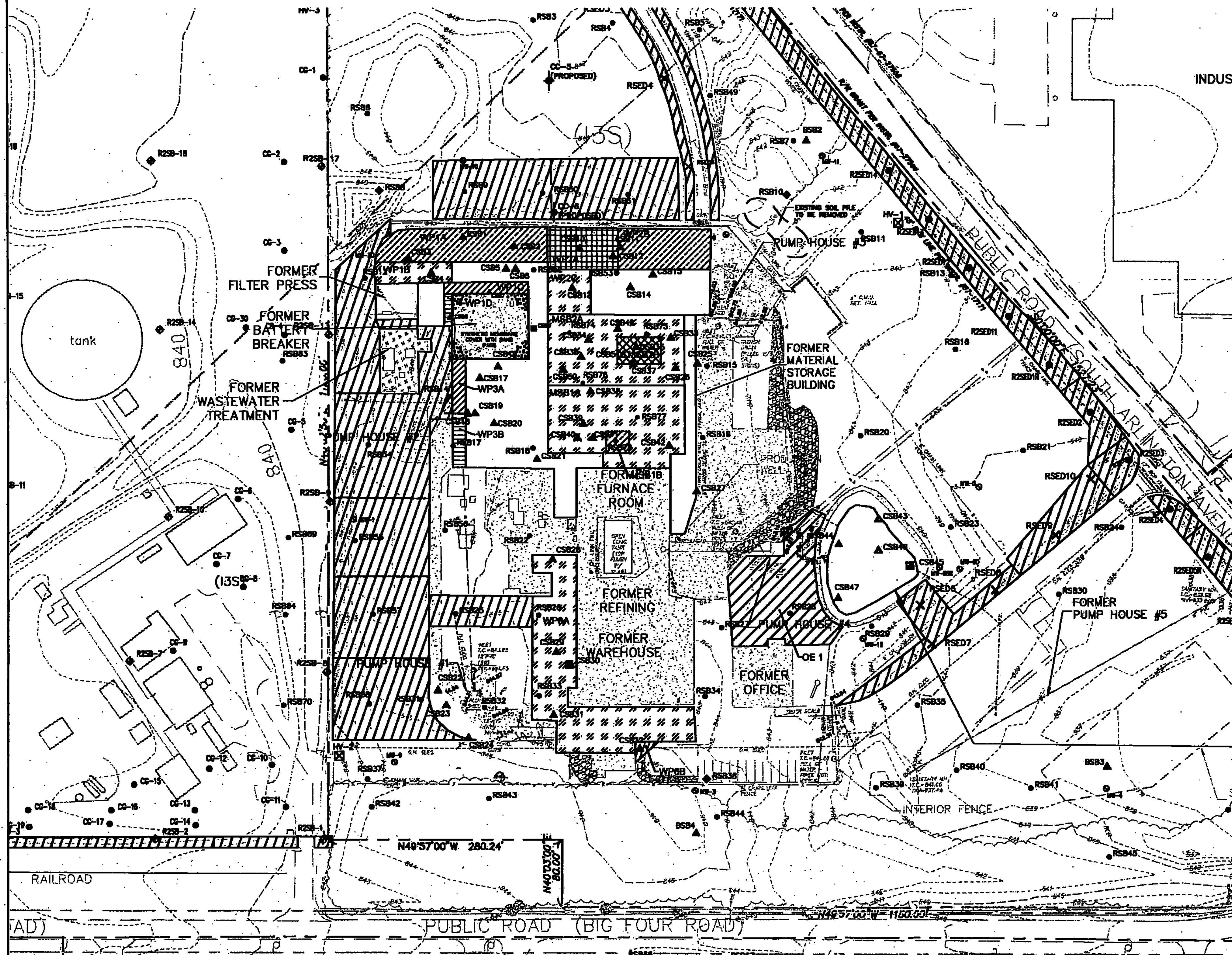
5

Scale	1"=50'
Designed by	J.W.D.
Drawn by	P.S.G.
Checked by	J.W.D.
Project Mgr	P.G.S.
Project No.	2003-1048
Sheet No.	5 OF 12

GRAPHIC SCALE
(IN FEET)
1 inch = 50 ft.

NOT FOR CONSTRUCTION

OCT 06 2010



EXCAVATION SUMMARY TABLE				XRF SCREENING & LAB ANALYZED	
EXCAVATION I.D.	AREA (sf)	REMOVAL DEPTH (ft)	REMOVAL VOLUME (cf)	# OF CONFIRMATION SAMPLES REQUIRED	# OF SIDEWALL SAMPLES REQUIRED
WP1A	8033.07	2.5	20082.68	5	10
WP1B	2300.40	1.0	2300.40	3	2
WP1C	1388.50	1.3	1805.05	3	6
WP1D	362.56	3.3	1196.45	3	2
WP2A	4206.60	7.3	30708.12	3	9
WP2B	5336.81	2.5	13342.03	3	5
WP2C	2773.38	1.0	2773.38	3	4
WP3A	1046.51	1.3	1360.46	3	3
WP3B	1005.24	3.3	3317.29	3	4
WP6A	17812.19	1.0	17812.19	10	0
WP6B	350.71	1.3	455.92	3	1
MSB1A	13833.45	1.0	13833.45	10	13
MSB1B	711.21	2.5	1778.03	3	5
MSB2A	12124.90	1.0	12124.90	10	13
MSB2B	1661.31	6.0	9967.86	3	6

LAGOON: REMOVE ACCUMULATED WATER FOR TREATMENT AND MANAGEMENT THROUGH TEMPORARY TREATMENT SYSTEM. REMOVE VEGETATION, SEDIMENT AND GEOMEMBRANE AND DISPOSE IN CONTAINMENT CELL. PRESSURE WASH CONCRETE SURFACE. DEMOLISH CONCRETE AND SEGREGATE FOR POSSIBLE CRUSHING AND REUSE. PERFORM CONFIRMATORY SAMPLING OF REMAINING SOIL.

NOT FOR CONSTRUCTION

NORTH

GRAPHIC SCALE

(IN FEET)
1 inch = 50 ft.

LEGEND

- Existing Contour
- Existing Building
- Former Building Footprint
- Existing Edge of Paving
- Existing Right of Way
- Existing Tree Line
- Existing Wetland Limit Line
- Existing Flood Plain Limit Line
- Existing Lot Line
- Property Line (Approximate)
- Existing Sanitary Sewer
- Existing Stormwater Line w/ Inlet
- Existing Water Line
- Existing Gas Line
- Existing Electric Line
- Existing Utility Pole
- RCRA HWMU That does not Require Soil Removal
- 12" Removal Depth
- 18" Removal Depth
- 30" Removal Depth
- 36" Removal Depth
- 72" Removal Depth
- 87" Removal Depth
- MW-11 Monitoring Well
- CSB30 Approximate Soil Sample Location
- CSB28 Soil Sample Location/Designation Surveyed by the Schneider Corp., Indianapolis, Indiana
- RSB77 Soil Sample Location/Designation Surveyed by the Schneider Corp., Indianapolis, Indiana
- Phase II RFI Soil Sampling
- Sediment Sample Location S. Arlington Ave. Drainage Ditch
- Sediment Sample Location S. Arlington Ave. Drainage Ditch
- RSED3 Sediment Sample Location in Grassy Area Swales
- CC-1 (PROPOSED) Containment Cell Groundwater Monitoring Well (To be installed prior to start of CM construction by RMC)

NOTES:

1. TOPOGRAPHIC SURVEY WITHIN REFINED METALS PROPERTY OBTAINED FROM FIELD SURVEY PERFORMED BY THE SCHNEIDER CORPORATION AUGUST, 2010. ORIGINATING BENCHMARK INDIANA DEPARTMENT OF TRANSPORTATION BRONZE DISC STAMPED "MAR G-354" ELEVATION 862.48 (NGVD 29).
2. TOPOGRAPHIC INFORMATION OUTSIDE OF REFINED METALS PROPERTY OBTAINED FROM IMAGIS CITY OF INDIANAPOLIS BASED ON NGVD 29.
3. BUILDINGS ON THE REFINED METALS PROPERTY HAVE BEEN DEMOLISHED, EXCEPT PUMP HOUSES #1 THROUGH #4.
4. SOIL REMOVAL DEPTHS MEASURED FROM TOP OF ORIGINAL GROUND SURFACE.

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1055 ANDREW DRIVE, SUITE A
WEST CHESTER, PENNSYLVANIA 19380

REFINED METALS CORPORATION
BEECH GROVE, INDIANA

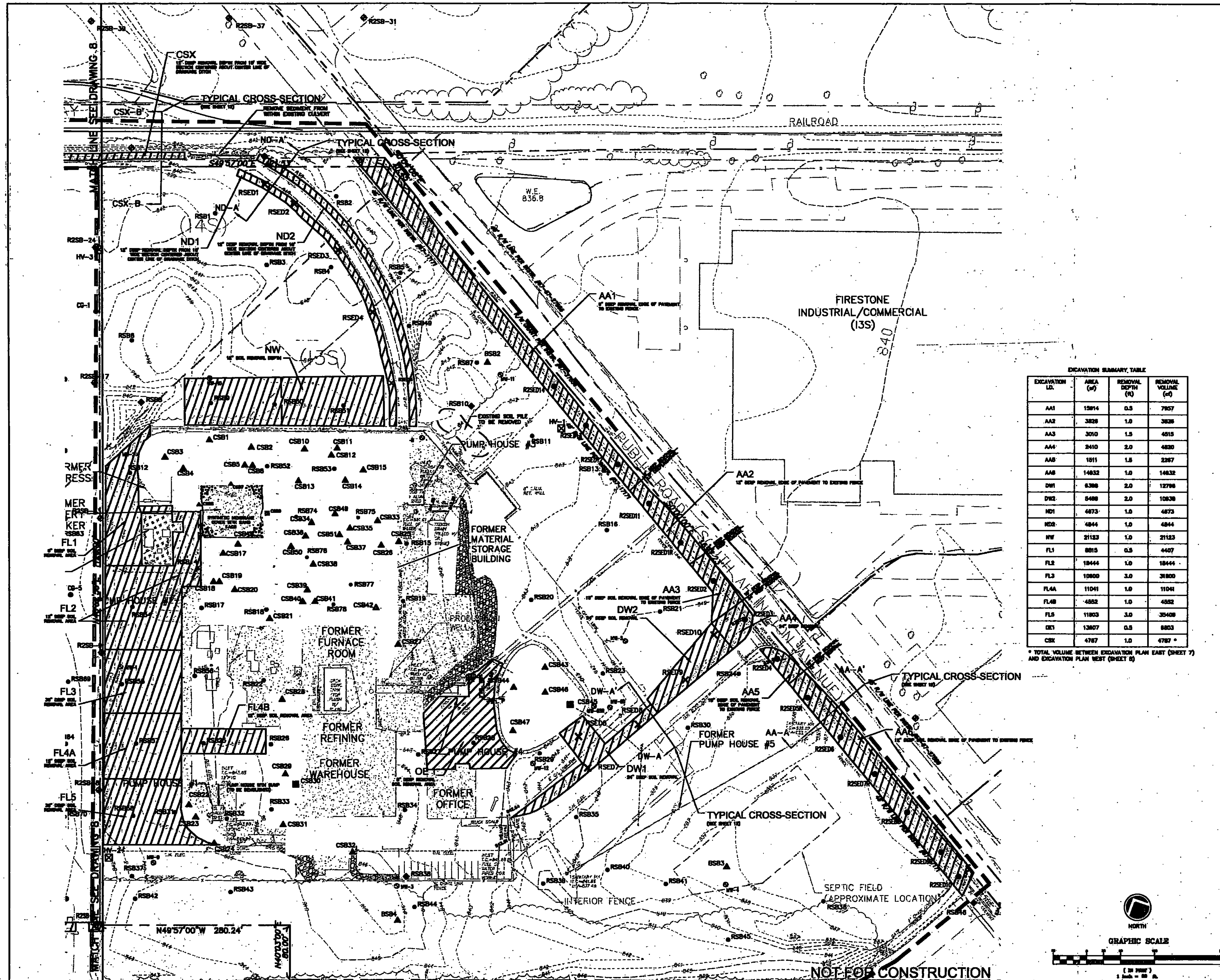
CORRECTIVE MEASURES DESIGN
FINAL DESIGN

HAZARDOUS WASTE MANAGEMENT
UNIT CLOSURE PLAN

6

Scale	1"=50'
Designed by	J.W.D.
Drawn by	P.S.G.
Checked by	J.W.D.
Project Mgr.	P.G.S.
Project No.	2003-1046
Sheet No.	6 OF 12

OCT 06 2010



EXCAVATION SUMMARY TABLE

EXCAVATION I.D.	AREA (sf)	REMOVAL DEPTH (ft)	REMOVAL VOLUME (cf)
AA1	15914	0.5	7957
AA2	3826	1.0	3826
AA3	3010	1.5	4515
AA4	2410	2.0	4820
AA5	1511	1.5	2267
AA6	14832	1.0	14832
DW1	6398	2.0	12796
DW2	5468	2.0	10838
ND1	4873	1.0	4873
ND2	4844	1.0	4844
NW	21123	1.0	21123
FL1	8815	0.5	4407
FL2	18444	1.0	18444
FL3	10600	3.0	31800
FL4A	11041	1.0	11041
FL4B	4552	1.0	4552
FL5	11803	3.0	35409
OE1	13607	0.5	6803
CSX	4767	1.0	4787 *

* TOTAL VOLUME BETWEEN EXCAVATION PLAN EAST (SHEET 7) AND EXCAVATION PLAN WEST (SHEET 8)

LEGEND

NOTES:

1. TOPOGRAPHIC SURVEY WITHIN REFINED METALS PROPERTY OBTAINED FROM FIELD SURVEY PERFORMED BY THE SCHNEIDER CORPORATION AUGUST, 2010. ORIGINATING BENCHMARK INDIANA DEPARTMENT OF TRANSPORTATION BRONZE DISC STAMPED "MAR G-354" ELEVATION 862.48 (NGVD 29).

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ADVANCED GeoServices

Engineering for the Environment. Planning for People.™

REFINED METALS CORPORATION
BEECH GROVE, INDIANA

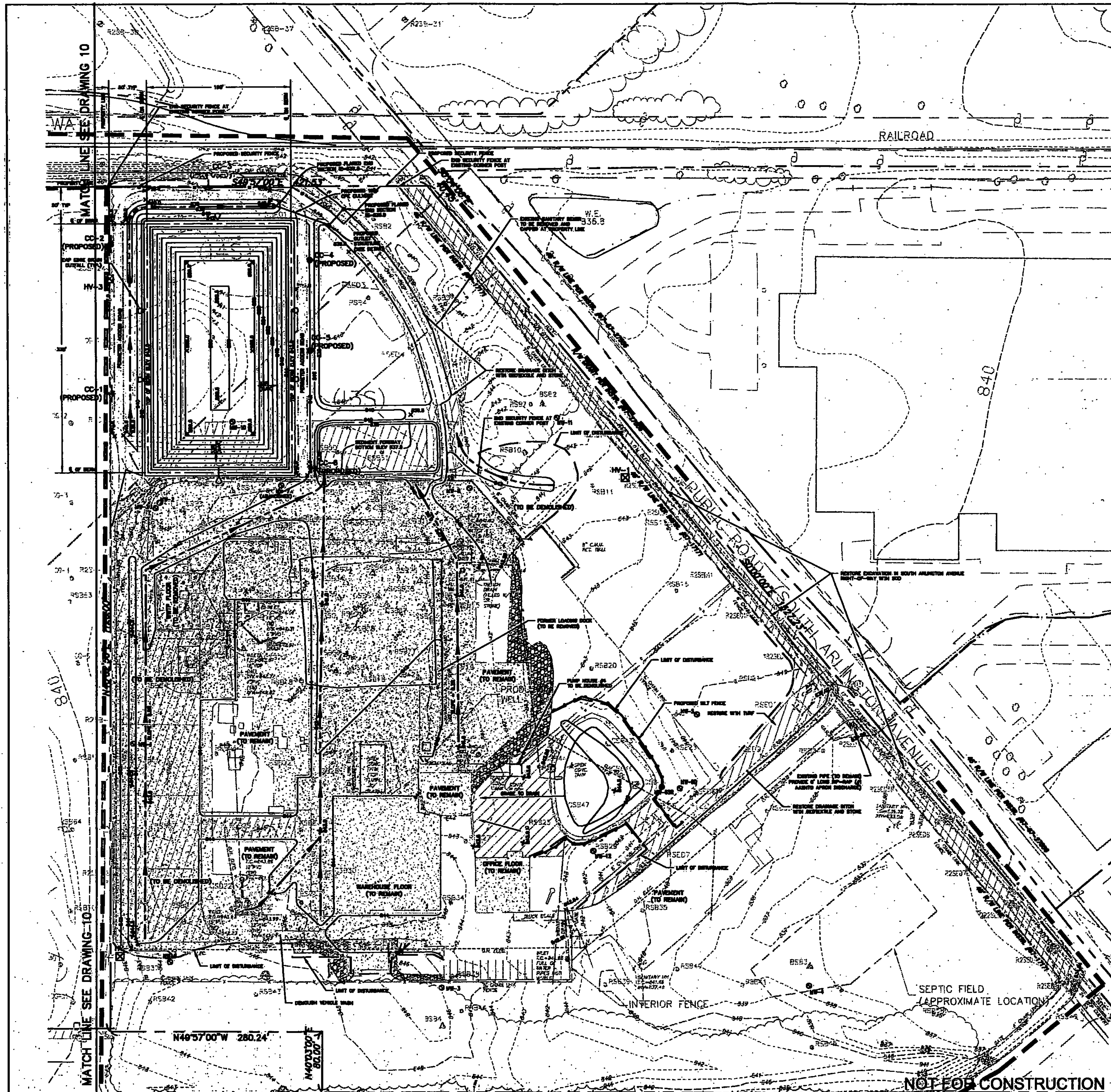
CORRECTIVE MEASURES DESIGN
FINAL DESIGN

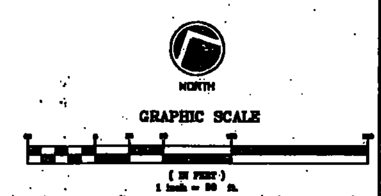
SOIL AND SEDIMENT
EXCAVATION PLAN (EAST)

7

Scale	1"=30'
Designed by	J.W.O.
Drawn by	P.S.G.
Checked by	J.W.O.
Project Mgr	P.G.S.
Project No.	2003-1046
Sheet No.	7 OF 12

OCT 06 2010





DATE	REVISION
9-14-10	REPLACED BASE MAP AND RESPONSE TO COMMENTS
10-6-10	REVISED TO FINAL DESIGN

LEGEND

- Existing Contour
- Existing Building
- Former Building Footprint
- Existing Edge of Paving
- Existing Right of Way
- Existing Tree Line
- Existing Wetland Limit Line
- Existing Flood Plain Limit Line
- Existing Lot Line
- Property Line (Approximate)
- Existing Sanitary Sewer
- Existing Stormwater Line w/ Inlet
- Existing Water Line
- Existing Gas Line
- Existing Electric Line
- Existing Utility Pole
- Non-HWMU Excavation Area with Excavation Depth in Inches
- Proposed Security Fence
- MW-11 Monitoring Well
- Approximate Soil Sample Location
- Soil Sample Location/Designation Surveyed by the Schneider Corp. Indianapolis, Indiana
- Soil Sample Location/Designation Surveyed by the Schneider Corp. Indianapolis, Indiana
- Phase II RFI Soil Sampling
- Sediment Sample Location S. Arlington Ave. Drainage Ditch
- Sediment Sample Location S. Arlington Ave. Drainage Ditch
- Sediment Sample Location in Grassy Area Swales
- Area to be Stabilized with Crushed Stone or Recycled Concrete
- Existing Impervious Surface to Remain

NOTES:

1. TOPOGRAPHIC SURVEY WITHIN REFINED METALS PROPERTY OBTAINED FROM FIELD SURVEY PERFORMED BY THE SCHNEIDER CORPORATION AUGUST, 2010. ORIGINATING BENCHMARK: INDIANA DEPARTMENT OF TRANSPORTATION BRONZE DISC STAMPED "MAR G-354" ELEVATION 882.48 (NGVD 29).

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1055 ANDREW DRIVE, SUITE A
WEST CHESTER, PENNSYLVANIA 19380

REFINED METALS CORPORATION
BEECH GROVE, INDIANA

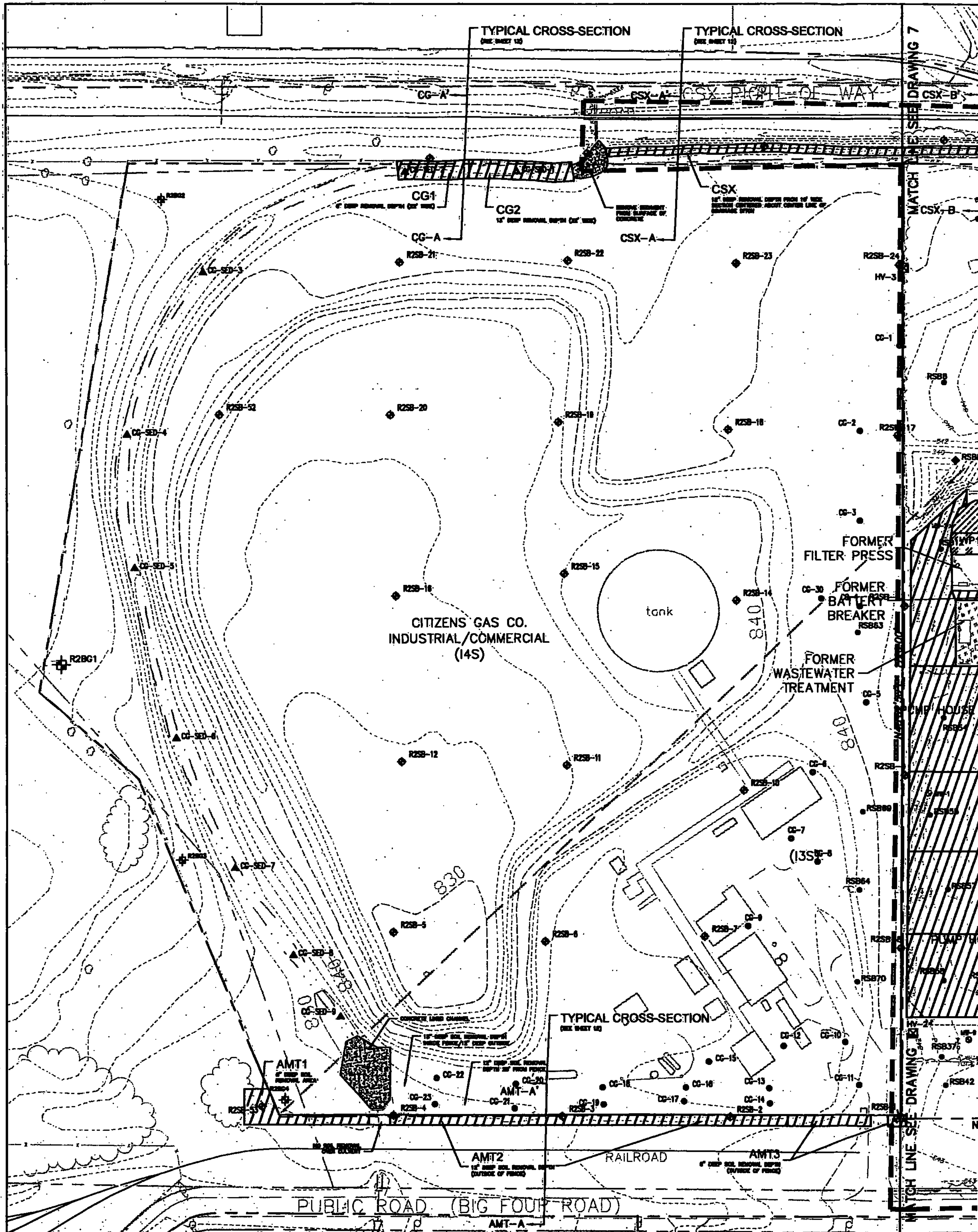
CORRECTIVE MEASURES DESIGN
FINAL DESIGN

RESTORATION AND FINAL EROSION AND SEDIMENT CONTROL PLAN (EAST)

9

Scale	1"=50'
Designed By	J.W.D.
Drawn By	P.S.G.
Checked By	J.W.D.
Project Mgr.	P.G.S.
Project No.	2003-1048
Sheet No.	9 OF 12

OCT 06 2010



NOT FOR CONSTRUCTION

NORTH

GRAPHIC SCALE

EXCAVATION SUMMARY TABLE

EXCAVATION I.D.	AREA (sf)	REMOVAL DEPTH (ft)	REMOVAL VOLUME (cf)
CSX	SEE	SHEET 7	TABLE
CG1	1871.41	0.5	935.71
CG2	2703.61	1.0	2703.61
AMT1	2743.38	0.5	1371.69
AMT2	5874.38	1.0	5874.38
AMT3	278.54	0.5	139.77

DATE	REVISION
9-14-10	REPLACED BASE MAP AND RESPONSE TO COMMENTS
10-6-10	REVISED TO FINAL DESIGN

LEGEND

- Existing Contour
- Existing Building
- Former Building Footprint
- Existing Edge of Paving
- Existing Right of Way
- Existing Tree Line
- Existing Wetland Limit Line
- Existing Flood Plain Limit Line
- Existing Lot Line
- Property Line (Approximate)
- Existing Sanitary Sewer
- Existing Stormwater Line w/ Inlet
- Existing Water Line
- Existing Gas Line
- Existing Electric Line
- Existing Utility Pole
- Non-HWMU Excavation Area with Excavation Depth in Inches
- Monitoring Well
- Approximate Soil Sample Location
- Soil Sample Location/Designation Surveyed by the Schneider Corp., Indianapolis, Indiana
- Soil Sample Location/Designation Surveyed by the Schneider Corp., Indianapolis, Indiana
- Citizens Gas Soil Sample (Field Located) Oct 2008
- Phase II RFI Soil Sampling
- Sediment Sample Location S. Arlington Ave. Drainage Ditch
- Sediment Sample Location S. Arlington Ave. Drainage Ditch
- Sediment Sample Location in Grassy Area Swales

NOTES:

1. BASE MAP FROM HERITAGE ENVIRONMENTAL SERVICES, INC. DRAWING No. 20190U22 DATED JULY 13, 1994. NO BENCHMARK PROVIDED ON REFERENCE DRAWING.

2. BUILDINGS ON THE REFINED METALS PROPERTY HAVE BEEN DEMOLISHED, EXCEPT PUMP HOUSES.

ADVANCED GeoServices

Engineering for the Environment. Planning for People.™

1055 ANDREW DRIVE, SUITE A
WEST CHESTER, PENNSYLVANIA 19380

REFINED METALS CORPORATION
BEECH GROVE, INDIANA

CORRECTIVE MEASURES DESIGN
FINAL DESIGN

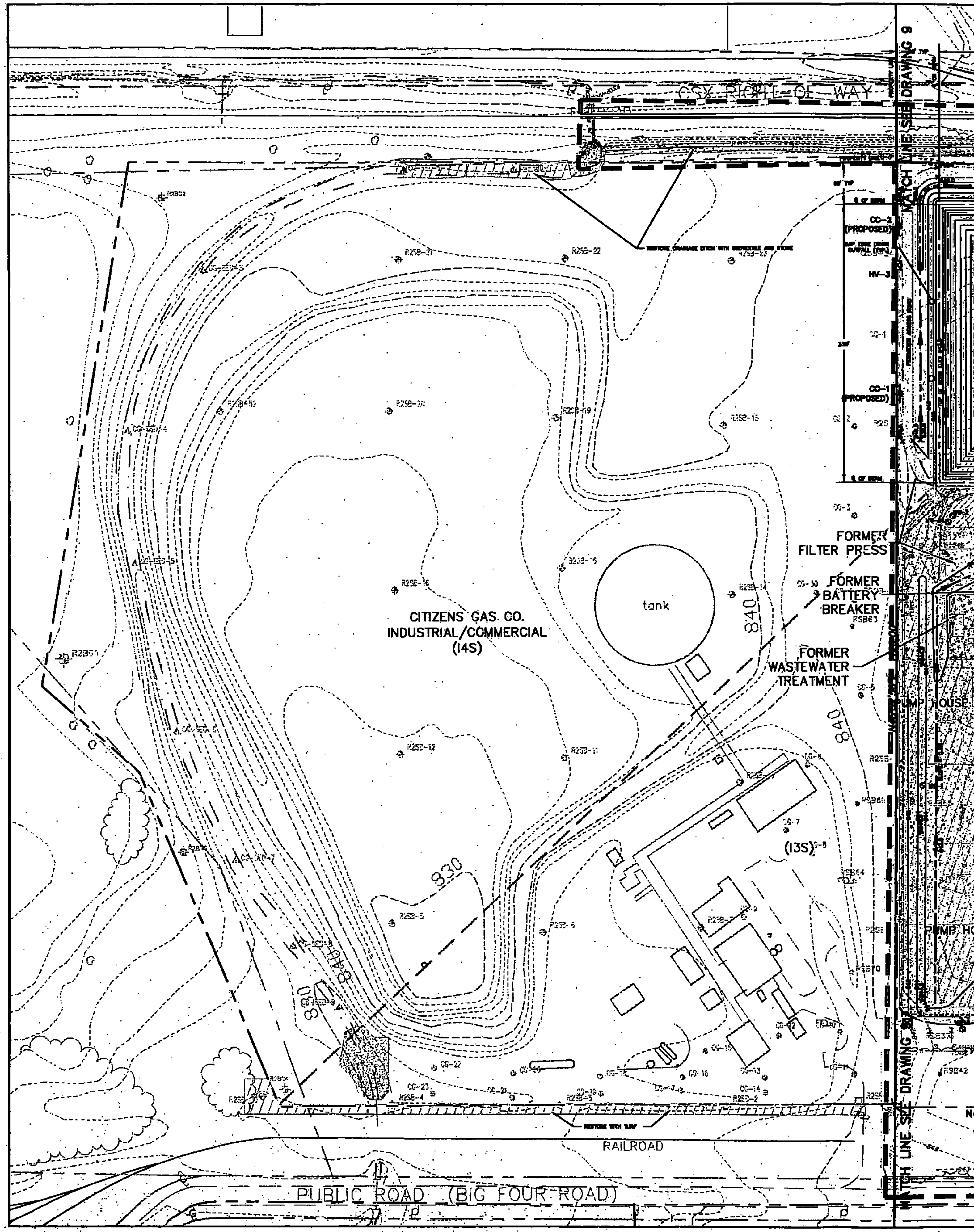
SOIL AND SEDIMENT
EXCAVATION PLAN (WEST)

8

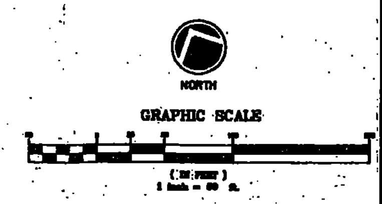
Scale	1"=50'
Designed by	J.W.D.
Drawn by	P.S.G.
Checked by	J.W.D.
Project Mgr.	P.G.S.
Project No.	2003-1046
Sheet No.	8 OF 12

OCT 06 2010

DATE	REVISION
9-14-10	REPLACED BASE MAP AND RESPONSE TO COMMENTS
10-6-10	REVISED TO FINAL DESIGN



NOT FOR CONSTRUCTION



LEGEND

- Existing Contour
- Existing Building
- Former Building Footprint
- Existing Edge of Paving
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- Existing Utility Pole
- Non-HWMU Excavation Area with Excavation Depth in Inches
- MW-11 Monitoring Well
- Approximate Soil Sample Location
- Soil Sample Location/Designation Surveyed by the Schneider Corp., Indianapolis, Indiana
- Soil Sample Location/Designation Surveyed by the Schneider Corp., Indianapolis, Indiana
- CG-7 Citizens Gas Soil Sample (Field Located) Oct 2008
- Phase II RFI Soil Sampling
- Sediment Sample Location S. Arlington Ave. Drainage Ditch
- Sediment Sample Location S. Arlington Ave. Drainage Ditch
- Sediment Sample Location in Grassy Area Swales

NOTES:

1. TOPOGRAPHIC SURVEY WITHIN REFINED METALS PROPERTY OBTAINED FROM FIELD SURVEY PERFORMED BY THE SCHNEIDER CORPORATION AUGUST, 2010. ORIGINATING BENCHMARK INDIANA DEPARTMENT OF TRANSPORTATION BRONZE DISC STAMPED "MAR G-354" ELEVATION 882.48 (NGVD 29).

2. TOPOGRAPHIC INFORMATION OUTSIDE OF REFINED METALS PROPERTY OBTAINED FROM IMAGIS CITY OF INDIANAPOLIS BASED ON NGVD 29.

3. BUILDINGS ON THE REFINED METALS PROPERTY HAVE BEEN DEMOLISHED, EXCEPT PUMP HOUSES #1 THROUGH #4.

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1055 ANDREW DRIVE, SUITE A
WEST CHESTER, PENNSYLVANIA 19380

REFINED METALS CORPORATION
BEECH GROVE, INDIANA

CORRECTIVE MEASURES DESIGN
FINAL DESIGN

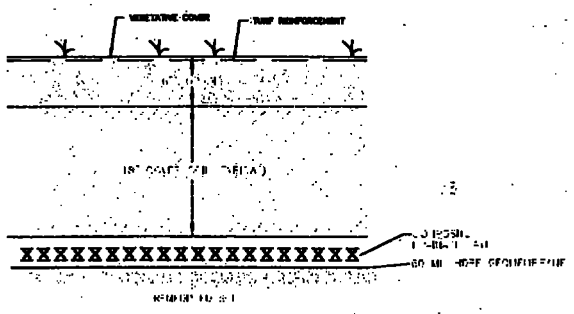
RESTORATION AND FINAL EROSION AND SEDIMENT CONTROL PLAN (WEST)

10

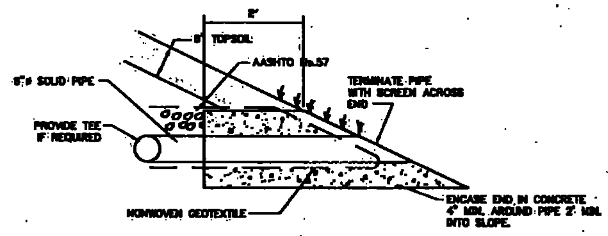
Scale	1"=50'
Designed By	J.W.D.
Drawn By	P.S.G.
Checked By	J.W.D.
Project Mgr.	P.G.S.
Project No.	2003-1046
Sheet No.	8 OF 12

OCT 06 2010

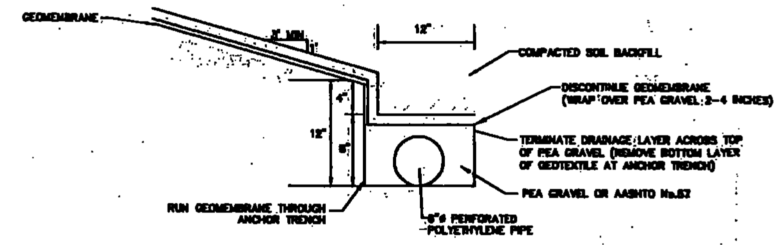
DATE	REVISION
9-14-10	REPLACED BASE MAP AND RESPONSE TO COMMENTS
10-6-10	REVISED TO FINAL DESIGN



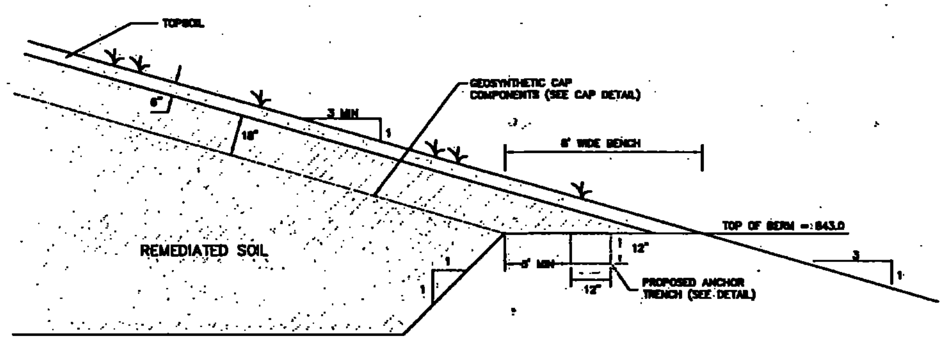
CAP DETAIL 1/11
NOT TO SCALE



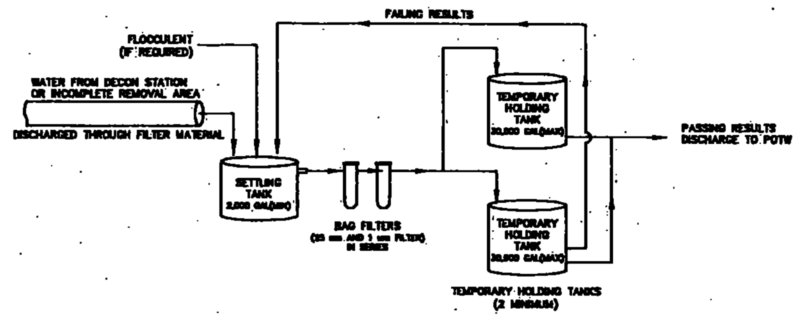
CAP DRAIN OUTFALL 2/11
NOT TO SCALE



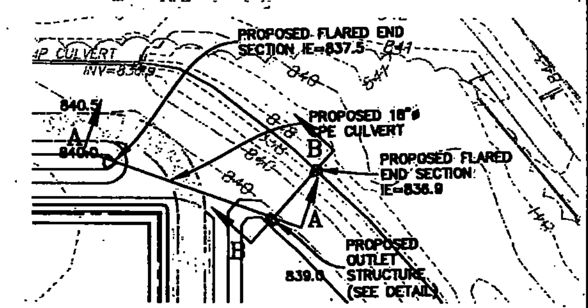
ANCHOR TRENCH 3/11
NOT TO SCALE



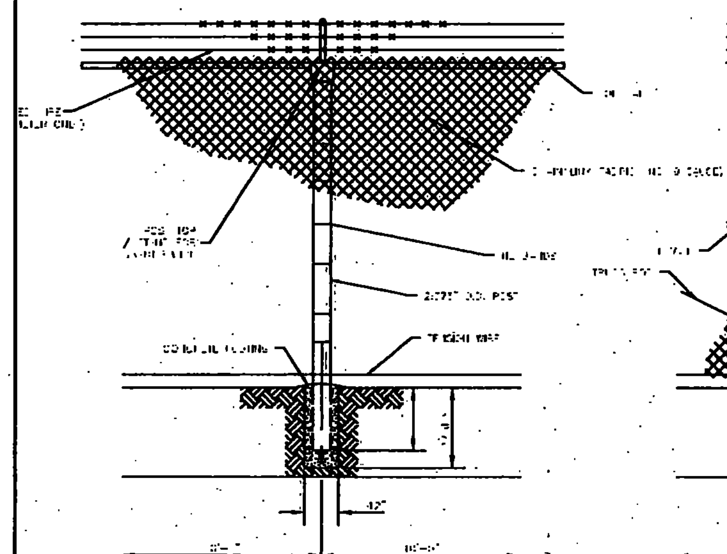
CAP TERMINATION 4/11
NOT TO SCALE



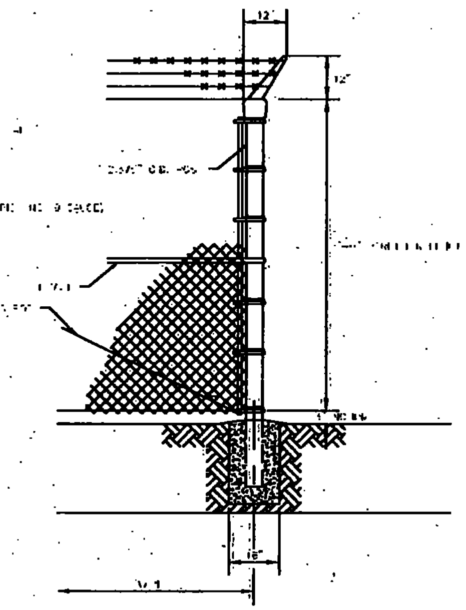
PROCESS FLOW DIAGRAM 5/11
NOT TO SCALE



PLAN VIEW

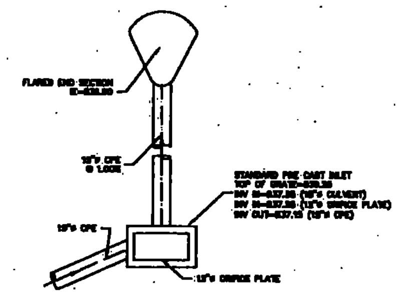


TYPICAL LINE POST DETAIL

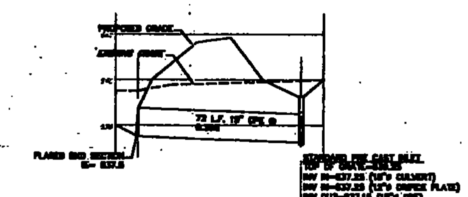


TYPICAL END, CORNER, AND PULL POST DETAIL

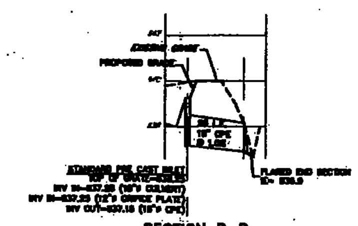
FENCE DETAILS 6/11
NOT TO SCALE



STORMWATER MANAGEMENT BASIN OUTLET STRUCTURE 7/11
NOT TO SCALE



SECTION A–A



SECTION B–B

STORMWATER MANAGEMENT BASIN CULVERT PROFILES 8/11

NOT FOR CONSTRUCTION

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REFINED METALS CORPORATION
BEECH GROVE, INDIANA

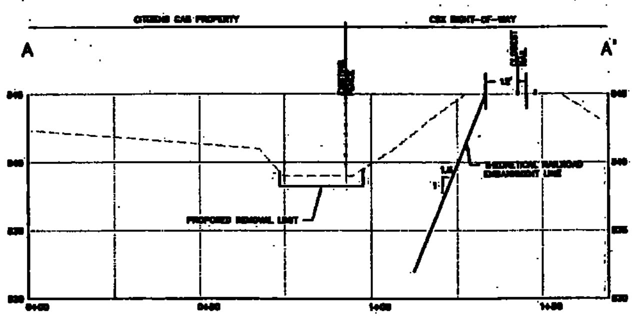
CORRECTIVE MEASURES DESIGN
FINAL DESIGN

CONSTRUCTION DETAILS

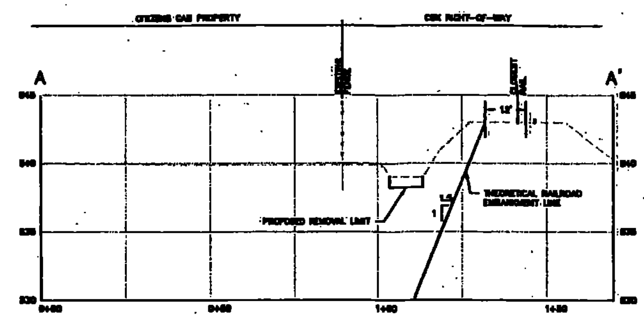
11

Scale	N.T.S.
Designed By	J.W.D.
Drawn By	P.S.G.
Checked By	J.W.D.
Project Mgr	P.G.S.
Project No.	2003-1046
Sheet No.	11 OF 12

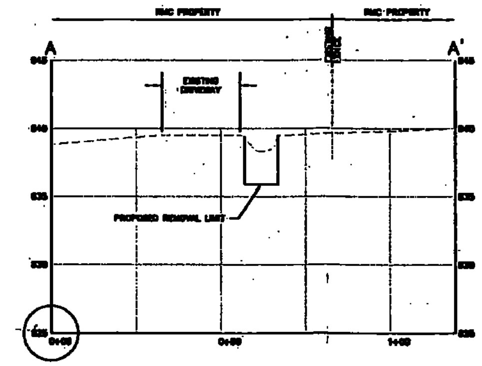
OCT 06 2010



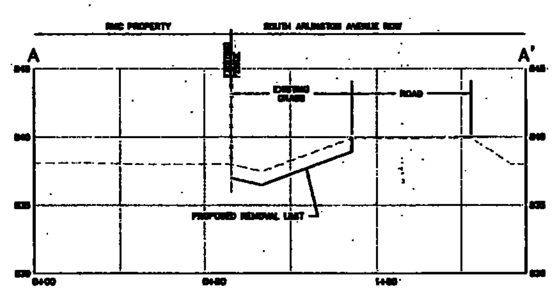
CITIZENS GAS (CG) SECTION A–A'
1" = 20' H
1" = 5' V



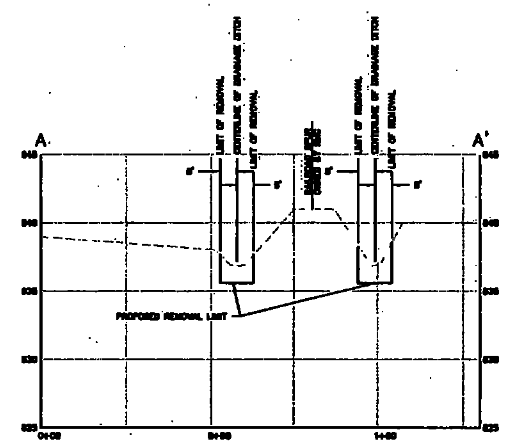
CSX RIGHT–OF–WAY SECTION A–A'
1" = 20' H
1" = 5' V



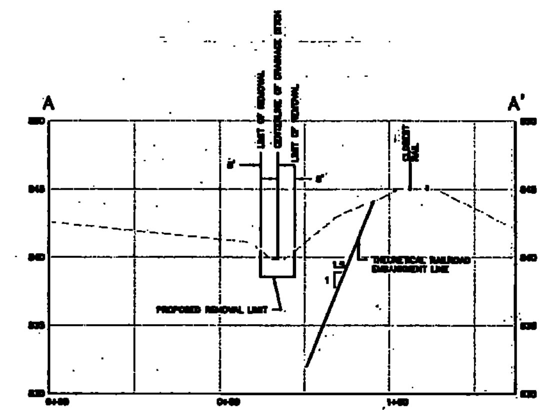
DRIVEWAY (DW): SECTION A–A'
1" = 20' H
1" = 5' V



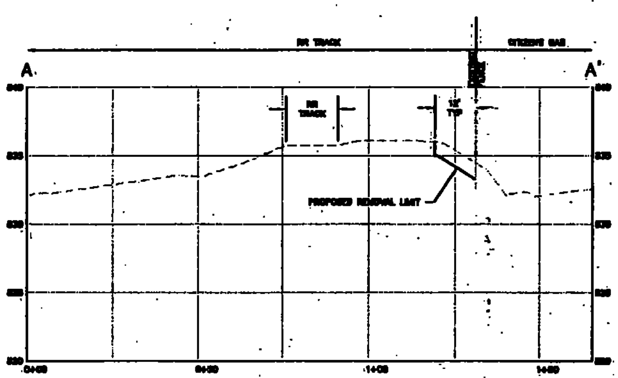
SECTION AA–A – AA–A'
1" = 20' H
1" = 5' V



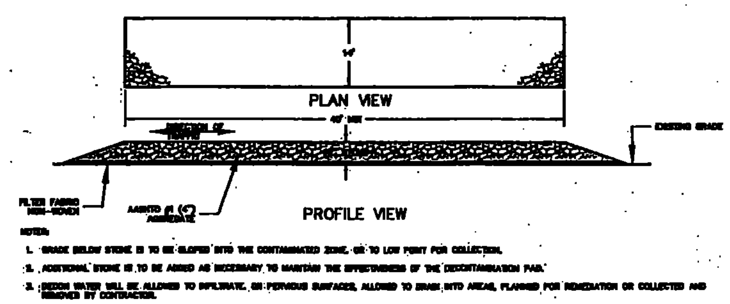
SECTION ND–A – ND–A'
1" = 20' H
1" = 5' V



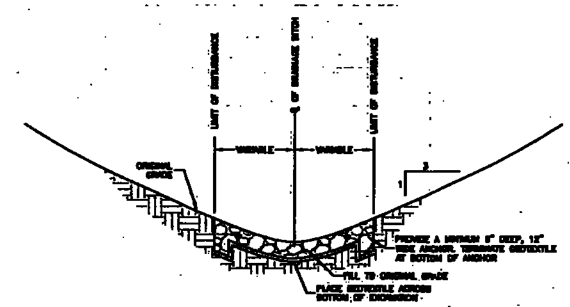
SECTION CSX–B – CSX–B'
1" = 20' H
1" = 5' V



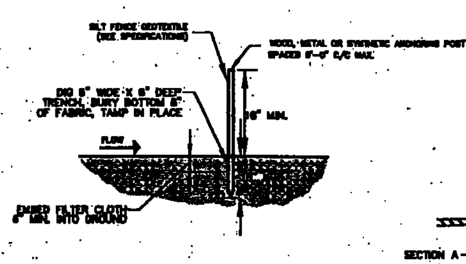
SECTION AMT–A – AMT–A'
1" = 20' H
1" = 5' V



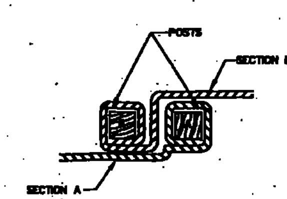
CONTAMINANT REDUCTION ZONE (CRZ)
N.T.S.



TYPICAL DRAINAGE DITCH RESTORATION DETAIL (GEOTEXTILE AND STONE)
N.T.S.



DETAIL: SILT FENCE
N.T.S.



JOINING SECTIONS OF FABRIC FENCE
N.T.S.

NOT FOR CONSTRUCTION

NOTES:

1. BASE MAP FROM HERITAGE ENVIRONMENTAL SERVICES, INC. DRAWING No. 2619OU22 DATED JULY 13, 1994. NO BENCHMARK PROVIDED ON REFERENCE DRAWING.

2. BUILDINGS ON THE REFINED METALS PROPERTY HAVE BEEN DEMOLISHED, EXCEPT PUMP HOUSES #1 THROUGH #4.

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REFINED METALS CORPORATION
BEECH GROVE, INDIANA

CORRECTIVE MEASURES DESIGN
PRE–FINAL DESIGN

CONSTRUCTION DETAILS

12

Scale	1"=50'
Designed By	J.W.D.
Drawn By	P.S.G.
Checked By	J.W.D.
Project Engr	P.G.S.
Project No.	2003-1046
Sheet No.	12 OF 12

OCT 06 2010

ATTACHMENT B

Construction Specifications

ATTACHMENT B

Construction Specifications

DIVISION 1
GENERAL REQUIREMENTS

DIVISION 2
SITE WORK

SPECIFICATIONS

DIVISION 1

SPECIFICATIONS

DIVISION 1

SECTION 01010

SUMMARY OF WORK

PART 1: GENERAL

1.1 DESCRIPTION OF WORK

The Work to be performed under these Specifications represents the proposed Corrective Measures to be completed by Refined Metals Corporation (RMC) to address elevated concentrations of lead and associated inorganic compounds in soil, sediment and groundwater identified on and around the RMC facility in Beech Grove, Marion County, Indiana. Major components of the Work include the following:

A. Installation and maintenance of erosion and sediment control measures, storm water management controls, temporary access controls, and decontamination facilities associated with the proposed work.

B. Clearing, grubbing and disposal of brush and trees from within areas of proposed remediation and containment cell construction.

C. Construction of a containment cell for consolidation of excavated soil, "sediment", and designated debris.

D. Excavation of on-site soil exceeding 970 mg/kg total lead, 37 mg/kg antimony, 20 mg/kg arsenic, 77 mg/kg cadmium and 53 mg/kg selenium within HWMU areas, as shown on the Hazardous Waste Management Unit Closure Plan (Sheet 6).

E. Closure of the on-site surface impoundment (lagoon) and demolition of its concrete liner component following removal of liquid, bulk sediment, vegetation, liner material and miscellaneous debris.

F. Excavation of on-site soil from areas outside the HWMUs exceeding 4,954 mg/kg total lead in "grassy" exposure areas and 8,470 mg/kg total lead in paved exposure areas, as shown on Soil and Sediment Excavation Plan East (Sheet 7).

G. Excavation of soil and "sediment" exceeding 400 mg/kg total lead in off-site areas, as shown on Soil and Sediment Excavation Plans East and West (Sheets 7 and 8).

H. Handling, loading, transporting and placement of excavated materials in the containment cell.

I. Identification of borrow sources for; and procurement of topsoil, structural soil fill, general site fill, cap soil fill, and granular fill meeting the requirements of these Specifications.

J. Restoration of those areas of the site disturbed as a result, directly or indirectly, of the soil excavation activities and associated work.

K. Mobilization and operation of a temporary water treatment system for accumulated stormwater and groundwater from disturbed site areas and decontamination water.

L. Operation of existing storm water management system (pumps and piping) from the time of mobilization through site stabilization and initiation of gravity storm water drainage through proposed discharge features.

M. Establish stormwater drainage and management system capable of capturing, controlling and discharging stormwater runoff without the use of pumps.

1.2 RELATED SECTIONS

A. Corrective Measures Design (including all Attachments)

B. All Sections of these Specifications

1.3 CONTRACTOR RESPONSIBILITIES

A. Furnish all materials, tools, equipment, supervision, administration and transportation, and perform all labor and services necessary to furnish, deliver, construct, install, and/or complete all Work described in the Contract.

B. As necessary for proper execution and completion of work and as applicable, secure and pay for required permits, licenses, health and safety training, and medical monitoring for its own employees working at the site.

C. Provide at least 2 weeks advanced notification of commencement of mobilization.

D. Locate and protect existing utilities prior to working in or adjacent to areas containing existing utilities pursuant to the requirements of the Indiana One-Call system and through the use of a private utility locator.

E. Until final acceptance of the Work by RMC, the Contractor shall have the charge and care thereof and shall take every reasonable precaution against injury or damage to the completed work. The Contractor shall repair, restore, and make good, to the satisfaction of RMC all damages to any portion of the work before final acceptance and shall bear the expense thereof.

F. Contractor shall provide experienced, competent and trained personnel to perform the Work. Contractor shall provide, at a minimum, a project superintendent familiar with all details of the project, adept at the designated position and capable of communicating with Contractor personnel, and representatives of RMC, USEPA, and IDEM.

G. Contractor shall be responsible for providing barriers, safety guards, signage and temporary fencing as required by the owners of the properties where work is being performed, and as required by appropriate safety regulations.

1.4 CONTRACTOR USE OF WORKSITE

A. General

1. The Contractor shall confine operations at the site to areas indicated on the design drawings and shall not unreasonably encumber the site with any materials or equipment.

2. The Contractor shall limit their work on properties not owned by RMC to between the hours of 7:00 a.m. and 6:00 p.m., Monday through Friday, except legal holidays. Work on RMC property shall be limited to 6:00 a.m. to 7:00 p.m., Monday through Friday and Saturday 7:00 a.m. to 5:00 p.m., unless otherwise restricted by local ordinance. Additional working hours, or work on Sundays will only be permitted with prior approval by RMC.

3. Keep existing driveways and entrances serving the site clear and available at all times.

4. Consider the safety of the Work, and that of people and property on and adjacent to worksite, when determining amount, location, movement,

installation, and use of materials and equipment on worksite. Work zone safety fencing shall be used to demark active work zones outside the site security. Within the site security fence the Contractor shall provide protection around work zones in accordance with applicable regulatory statutes and as necessary to prevent uncontrolled access.

5. Site security shall be the Contractor's responsibility. RMC will maintain part-time dusk to dawn security service that consists of an unarmed guard visiting the site at irregular intervals during the night. RMC is not responsible for security of Contractor's equipment and materials.

6. Protect the general public from construction-related activities, conduct work in a manner, which will ensure that pedestrian and vehicular traffic will either not be obstructed or obstructed to the least possible degree.

7. Work on non-RMC property will be subject to limits and restrictions imposed by property owner.

1.5 EXISTING CONDITIONS

A. The existing conditions represented on the design drawings are based on the best available information obtained from one or any combination of the following sources: field survey, aerial photographs, reference drawings, or visual evaluations. The Contractor shall retain an Indiana Licensed Professional Surveyor to document starting conditions and establish vertical and horizontal controls for the project.

B. If conditions are significantly different to those presented on the design drawings such that they could affect the schedule, cost or execution of the work, the Contractor shall submit a detailed description of the conditions observed within two work days of their identification.

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

Not Used.

END OF SECTION

SECTION 01050

FIELD ENGINEERING

PART 1: GENERAL

1.1 DESCRIPTION

A. Work included: This Section of the Specifications covers field engineering services required for proper completion of the Work including, but not limited to:

1. Establishing and maintaining lines and levels, including field locating the property north and west of the proposed Containment Cell.

2. Surveying pre-removal conditions (topography and physical features) within the limits of contaminated soils and sediment designated for removal, and establishing reproducible grids or cross-sections for controlling removal depths.

3. Documenting final removal limits using the grids and cross-sections described above.

4. Providing As-Built Drawings of restored site conditions as part of the final project closeout. As-Built Drawings shall also document the finished surface of the materials placed in the Containment Cell and top of the finished cap.

5. Structural design of shores, forms, and similar items provided by the Contractor (if any) as part of the means and methods of construction.

6. The Contractor will retain the services of an Indiana Licensed Professional Surveyor to perform pre-removal and as-built surveys. The Contractor may utilize his own equipment and personnel to provide grade control during excavation activities and document final removal limits, provided the techniques and equipment are acceptable to the QA Representative and tied into the vertical and horizontal controls established by the surveyor.

1.2 RELATED SECTIONS

A. Section 01300 - Submittals

B. Section 02110 - Site Clearing and Grubbing

C. Section 02115 - Erosion and Sediment Control Measures

D. Section 02209 - Excavation/Handling/Placement

E. Section 02210 - Earthwork

F. Section 02831 – Fencing

1.3 DEFINITIONS

A. As-Built Drawings – Drawings at a similar scale and level of detail as the design drawings showing an accurate record of all deviations from the approved design drawings and Specifications which may occur in the Work as actually constructed. The Contractor will be provided with electronic copies of the design drawings for use in development of the As-Built Drawings. As-Built Drawings shall be signed and sealed by the Contractor's surveyor.

1.4 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. A land surveyor licensed to practice in the State of Indiana shall be directly responsible for survey work performed by the Contractor.

C. RMC will retain the services of a full-time Quality Assurance (QA) Representative to observe and document progression of the work and collect required post-excavation samples and perform other activities specifically designated in the Construction Quality Assurance Plan (CQAP) and Specifications.

D. The Contractor will be responsible for providing appropriately qualified personnel to perform Quality Control (QC) testing throughout the project, including performing air monitoring, compaction testing, liner installation and material testing.

1.5 SUBMITTALS

A. Comply with the pertinent provisions of Section 01300.

B. The Contractor shall provide, at a minimum, As-Built Drawings, signed and sealed by the Contractor's Surveyor, for the following components:

1. The initial excavation/removal work areas documenting original conditions.

2. Areas of clearing and grubbing and demolition quantities.

3. The final elevations of the site and off-site work zones and limits of each type of restoration (i.e., seeded vegetation, sod, and crushed stone/concrete).

4. All the reasonable items requested by RMC to verify that the Work meets the requirements of the Contract.

The Contractor shall submit As-Built documentation for review by RMC, with the request for final payment or at the completion of the applicable phases of the work.

C. The Contractor shall prepare a Daily Report detailing any and all work and health and safety activities that were performed. **The Daily Report shall be prepared by noon the following work day and a copy submitted to the QA Representative**. Results of Quality Control sampling and testing shall be provided as attachments to the Daily Report.

D. Contractor shall prepare and submit a Construction Schedule presenting the planned sequence for execution of the work. The Construction Schedule shall identify the sequence of excavation activities on a removal area by removal area basis, planned start and end dates for each major tasks, and other relevant information required for control of the work. The schedule shall be updated at least every two weeks to show actual versus planned progress and reflect changes in the schedule.

PART 2: MATERIALS

Not Used.

PART 3: EXECUTION

Not Used.

END OF SECTION

SECTION 01200

PROJECT PROGRESS MEETINGS

PART 1: GENERAL

1.1 DESCRIPTION OF WORK

A. The Contractor will conduct project meetings throughout the construction period to enable orderly review during progress of Work and to provide for systematic discussion of problems. Project meetings will also include discussions regarding coordination and scheduling.

B. When requested by a property owner, the Contractor will be required to participate in a Pre-Construction Meeting specific to that property. At a minimum, this will include a meeting for work on Citizens Gas property. The agenda for such meetings will be established by RMC and the property owner. RMC will be responsible for issuing minutes for such meetings.

1.2 RELATED SECTIONS

A. All documents related to the Corrective Measures Design.

1.3 QUALITY ASSURANCE

A. The Contractor's Superintendent shall attend and participate in each project meeting and shall represent the Contractor consistent with the Contract and commit the Contractor to solutions and actions agreed upon during the project meetings.

B. The Contractor's relations with its subcontractors and discussions relative thereto, are the Contractor's responsibility. The Contractor will be required to include key subcontractors (such as the liner installer) in project meetings when related work is being planned or discussed.

1.4 SUBMITTALS

A. Agenda items:

1. To the maximum extent practicable, the QA Respresentative will advise the Contractor at least twenty-four (24) hours in advance of project meetings regarding items to be discussed during the meeting.

2. Technical questions requiring the QA Representative's, Engineer's or RMC's response shall be submitted in writing, at least one (1) day prior to the project meeting.

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

3.1 MEETING SCHEDULE

A. Project meetings will be held weekly at a regularly scheduled time and day to be mutually agreed upon between the Contractor, RMC and regulatory agencies. When work is being performed, planned, or discussed on non-RMC property, the property owners will also be invited to participate in the project meetings. From time to time or during periods of reduced activity, the frequency of the meeting may be switched to bi-weekly. The day and time of the meetings may be moved with concurrence of the Contractor, RMC, USEPA and IDEM.

3.2 MEETING LOCATION

A. The Contractor shall provide adequate space at the site for progress meetings and provide conference call capabilities for participation from remote locations.

3.3 PROJECT MEETINGS

A. Minimum agenda for each meeting:

1. Attendance

2. Review of safety issues/concerns and latest sampling results.

3. Review progress of Work since last meeting, including status of submittals for approval.

4. Identify problems, which impede planned progress.

5. Develop corrective measures and procedures to regain planned schedule, if applicable.

6. Contractor shall provide and discuss "two-week look ahead" activity schedule if the work is not progressing per the early start/finish activity dates as noted in the latest update of the approved schedule.

7. Complete other current business.

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1: GENERAL

1.1 DESCRIPTION

A. This Section of the Specifications covers all submittals including material specifications and manufacturer's data; proposed subcontractors qualifications and insurance information, panel placement plan for geomembrane installation, sequence of construction information, schedule, and borrow source testing information. Contractor shall make submittals utilizing a standardized transmittal form acceptable to the QA Representative.

B. Upon award of the Contract, but no later than fourteen (14) calendar days before mobilization the Contractor shall prepare a submittal register for review and approval by the QA Representative.

1.2 RELATED SECTIONS

A. The appropriate Sections of Division 1 and Division 2 of these Specifications.

1.3 SUBMITTAL REGISTER

A. The submittal register shall be submitted no later than fourteen (14) calendar days before mobilization. The submittal register shall include all submittal items listed in the Specifications and shall also provide the following information, at a minimum:

1. Project name;
2. Contractor's project or reference number;
3. Submittal title and description of item and Specification section;
4. Submittal reference number sequentially numbered; and
5. Columns for submittal date, response date and approval status.

B. The submittal register shall include blank rows for future addition of submittals that were not anticipated. Upon inclusion of additional line items in the submittal register, the Contractor shall resubmit an updated submittal register for use by RMC and the Engineer.

1.4 SUBMITTAL SCHEDULE

A. The Contractor is required to make submittals sufficiently in advance of delivery of associated materials or commencement of associated work to allow review and response by the QA Representative. While the QA Representative will strive to turnaround submittals as quickly as possible, the Contractor should anticipate that submittals will require 5 days for review and response. Submittals that are considered incomplete or item unacceptable will be returned and will require resubmission.

1.5 SUBMITTALS

A. The minimal information required for each submittal is found in its respective Section of these Specifications. The following is a partial list of submittals related to the project:

1. Construction Schedule and Narrative Sequence of Construction
2. Contractor's Health and Safety Plan
3. Subcontractor's Qualifications and Insurance Information
4. Temporary Water Treatment System Information
5. Geotechnical and Analytical Data for Proposed Borrow Sources
6. Manufacturers Specifications and Cut-Sheets for Materials
7. Geomembrane Installer's Panel Placement Plan
8. As-Built Drawings

B. A submittal cover sheet or transmittal sheet shall accompany each submittal and shall include all information specified in these Specifications. The transmittal sheets shall be sequentially numbered and shall be of the same format for all submittals.

C. Submittals will be reviewed by the QA Representative. Where appropriate, the QA Representative will solicit input from RMC or the Engineer regarding the adequacy/acceptability of the proposed item.

D. The Contractor shall apply a stamp or signature certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the Contract Documents.

E. The results of review of submittals will be used as follows:

1. NO EXCEPTIONS TAKEN;
2. PROCEED AS NOTED; REVISE AND RESUBMIT FOR RECORD;
3. DO NOT PROCEED; REVISE AND RESUBMIT;
4. REJECTED; or,
5. NOT APPLICABLE.

F. Submittals not in compliance with the Specifications will be returned to the Contractor for revision. Any loss of time and additional costs associated with resubmittal(s) are the Contractor's responsibility.

G. Submittals that are "Proceed as Noted" are for the purpose of expediting procurement of the intended work. The Contractor shall incorporate all corrections and resubmit revised submittal to QA Representative within seven (7) calendar days of the "Proceed as Noted" action. Payment for completed work that is related to the "Proceed as Noted" submittal will not be made until the corrected and final resubmittal is accepted in writing by the QA Representative.

1.6 SUBSTITUTIONS

A. "Or Equals" Substitutions

1. Equals Considered - Whenever a material or article required is specified or shown on the plans by using the name of the proprietary product or of a particular manufacturer or vendor, any material or article which will perform adequately the duties imposed by the general design, will be considered equal and satisfactory provided the material or article so proposed is of equal properties and function in the opinion of QA Representative.

2. The Contractor shall document each request with complete data substantiating compliance of the proposed Substitution with the Contract Documents. "Or Equal" requests will be considered only when substantiated by the Contractor's submittal of data documenting the "Or Equal" nature of material or article. A request constitutes a representation that the Contractor:

   a. Has investigated the proposed product and determined that it meets or exceeds the quality level of the specified product.

   b. Shall provide the same warranty for the substitution as for the specified product.

   c. Shall coordinate installation and make changes to other work, which may be required for the Work to be complete with no additional cost to RMC.

   d. Shall waive claims for additional costs or time extension, which may subsequently become apparent.

   e. Shall reimburse RMC for review or redesign services associated with review and approval.

   d. Shall waive claims for additional costs or time extension, which may subsequently become apparent.

3. The Contractor shall provide substitutions in a timely manner and in accordance with the CMD and the Contract with RMC, so as to not have a negative impact on the Construction Schedule.

1.7 PRODUCT DATA

A. Collect product data into a single submittal for each element of fabrication or system. Product data includes printed information such as manufacturer's installation instructions, catalog costs, standard color charts, roughing-in diagrams and templates, standard wiring diagrams and performance curves.

B. Mark each copy to show applicable choices and options. Where product data includes information on several products, some of which are not required, mark copies to indicate the applicable information.

C. Do not submit product data until compliance with requirements of the Contract Documents has been confirmed.

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

3.1 IDENTIFICATION OF SUBMITTALS

A. The Contractor shall consecutively number all submittals.

1. When resubmittal(s) is made for any reason, the Contractor shall transmit under a new letter of transmittal with a new transmittal number.

2. On resubmittals, the Contractor shall cite the prior transmittal number(s).

B. The Contractor shall maintain an accurate submittal log for the duration of the Work, showing current status of all submittals at all times. The Contractor shall make the submittal log available for review upon request.

3.2 GROUPING OF SUBMITTALS

A. Unless otherwise specified, the Contractor shall make submittals in groups containing all associated items to assure that information is available for checking of each item when it is received.

B. Partial and poorly prepared submittals will be rejected as not complying with the requirements of the Contract. The Contractor will be liable for related delays.

3.3 TIMING OF SUBMITTALS

A. In scheduling, the Contractor shall allow five (5) calendar days for review and processing by the QA Representative following its receipt of the submittal.

This review time will be increased for the submittal(s) that are so extensive that the five (5) calendar day turn around period is unreasonable, as determined by the QA Representative.

C. It is understood that work affected by the submittal may progress only after the QA Representative has returned the approved, signed and stamped transmittal cover sheet to the Contractor. The Contractor will be responsible for the repair, modification or removal of completed work, which had not been approved.

3.4 QA REPRESENTATIVE'S REVIEW

A. Review and Processing shall not relieve the Contractor from responsibility for errors, which may exist in the submitted data.

B. Revisions:

1. The Contractor shall make required revisions as noted on initial submittal.

2. If the Contractor considers any required revision to be a change, it shall so notify RMC in writing within 3 calendar days.

END OF SECTION

SECTION 01351

HEALTH AND SAFETY PLAN REQUIREMENTS

PART 1: GENERAL

1.1 DESCRIPTION

A. The Work of the Contract covered by this section shall include the development and implementation of a Health and Safety Plan (HASP) for all proposed Corrective Measures activities contemplated as part of the proposed Work. The Contractor shall provide all expertise, supervision, labor, materials, and equipment necessary to develop, prepare, and implement the Health and Safety Plan as detailed in this Section and as accepted by USEPA, IDEM and RMC.

B. The Contractor shall develop and implement all necessary precautions for the safety of, and provide the necessary protection to prevent damage, injury or loss to:

- All employees and subcontractors participating in performance of the Work.
- All components of the Work, any materials to be used or incorporated in the Work, and any equipment to be employed in the execution of the Work, whether on- or off-site.
- Other property on or adjacent to the project site including trees, shrubs, lawns, fences, sidewalks, pavements, roadways, structures and utilities not designated for removal, relocation, or replacement in the course of construction.
- Adjacent property of owners/landowners and residents.

1.2 RELATED SECTIONS

A. All of the CM Design (including all attachments).

B. United States Federal Government - Code of Federal Regulations (CFR)

1. 29 CFR 1910 – Occupational Safety and Health Standards

2. 29 CFR 1910.120 - Hazardous Waste Operations and Emergency Response

3. 29 CFR 1910.134 - Respiratory Protection

4. 29 CFR 1910.1200 - Hazard Communication

5. 29 CFR 1926 - Construction Standards

6. 29 CFR 1910.1025 – Lead in Construction

1.3 QUALITY ASSURANCE

A. The Contractor's draft Health and Safety Plan (HASP) will be reviewed for content by the USEPA, IDEM and RMC. Each will return comments within one week from receipt of the draft HASP.

B. The Contractor shall carefully review and consider all elements of the Work of the Contract during preparation of the HASP and verify that all elements of the Contract Documents are thoroughly addressed. Incomplete or missing elements in the HASP will create delays in approval which will delay the commencement of Work.

1.4 GENERAL PLAN REQUIREMENTS

A. The Contractor shall develop a written site-specific HASP which complies with applicable regulations under the Code of Federal Regulations prior to commencing any on-site work and continue to implement, maintain, and enforce the HASP until final demobilization from the site.

B. The health and safety guidelines contained herein are intended to provide for a safe and minimal risk working environment for on-site personnel and to minimize the impact of activities involving contact with excavated soils on the general public and the surrounding environment.

C. The Contractor shall be responsible for the safety of persons and property on the site and for the protection of persons off the site and the environment to the extent that it may be affected by the conduct of the Work. The Contractor shall comply with and enforce compliance by employees of the Contractor and subcontractors with safety requirements of the CMD, laws and regulations, and HASP.

D. Hazard Communication Requirements:

1. The Contractor shall comply with the requirements of OSHA's Hazard Communication rule, 29 CFR 1910.1200, obtaining information on any hazardous chemical or harmful physical agent to which personnel of the Contractor and subcontractors, and visitors have potential exposure during the Work.

2. The Contractor shall include Material Safety Data Sheet (MSDS) documentation on any hazardous chemicals that the Contractor and/or its subcontractor's plan to utilize for the Work. In addition, the Contractor shall be responsible for meeting container warning label requirements in accordance with OSHA.

E. Work Stoppage: The Contractor shall give precedence to the safety and health of the public and on-site personnel and the protection of the environment for all Work. The Contractor's designated health and safety officer shall be responsible for decisions regarding when the Work will be stopped and re-started for health or safety considerations. The Contractor shall be responsible for all costs and delays at no extra cost to RMC.

F. Unforeseen Hazards: Should any unforeseen or site-specific safety-related factor, hazard, or condition become evident during performance of the Work at the Site, the Contractor shall bring such to the attention of RMC verbally and in writing as quickly as possible, for resolution. In the interim, the Contractor shall take prudent action to establish and maintain safe working conditions and to safeguard employees of Contractor and its subcontractors, the public, the property owner, RMC and its representatives, and regulators.

1.5 BASIS OF PROGRAM

A. OSHA standards and regulations contained in 29 CFR 1910 and 1926 provide the basis for the health and safety program. The program also reflects the position of USEPA and NIOSH regarding procedures recommended or required to ensure safe operations at sites containing hazardous or toxic materials.

1.6 SITE CHARACTERIZATION

A. Based on past sampling activities, work at the site will involve contact with materials containing lead, arsenic and other metals. Results of soil and sediment sampling are provided in the design drawings.

1.7 SUBMITTALS

A. The Contractor shall submit the draft Health and Safety Plan (HASP) in electronic format to RMC for review and comment at least two weeks prior to the start of work. The Contractor's HASP shall include, but is not limited to, required drawings, figures, tables, forms, resumes and appendices.

B. The Contractor shall not proceed with the Work until RMC, the USEPA and IDEM have accepted the Contractor's HASP.

C. The Contractor's HASP shall be a stand alone document that correlates health and safety procedures to each work element in a clear and concise manner.

D. Health and Safety Plan shall include the following:

1. Site control measures in accordance with 29 CFR 1910.120 (d) and 29 CFR 1926.65 (d).

2. A safety and health risk or hazard analysis for each site task and operation, including measures or controls for each task/operation.

3. Personnel training assignments in accordance with 29 CFR 1910.120 (e) and 29 CFR 1926.65 (e), 29 CFR 1910.1001 (j), and 29 CFR 1910.1025 (l).

4. Personal protective equipment to be used by personnel for each site task and operation being conducted in accordance with 29 CFR 1910.1209 (g)(5) and 29 CFR 1926.65 (G)(5).

5. Medical surveillance requirements in accordance with 29 CFR 1910.120 (f) and 29 CFR 1926.65 (f).

6. Frequency and types of air monitoring, personnel monitoring, and environmental sampling techniques and instrumentation to be used, including methods of maintenance and calibration of monitoring and sampling equipment to be used.

7. Decontamination procedures in accordance with 29 CFR 1910.120 (k) and 29 CFR 1926.65 (k).

8. A written respiratory protection program for project activities.

9. Procedure for dealing with heat and/or cold stress.

E Air Monitoring Reporting: **<u>Submit daily</u>**, on a separate Contractor designated form, air monitoring results.

PART 2: PRODUCTS AND PERSONNEL

2.1 DESIGNATED HEALTH AND SAFETY OFFICER

A. Employ and assign to the Work a competent and authorized representative herein referred to as the Health and Safety Officer. Health and Safety Officer Qualifications:

1. Site-related working experience specific to the activities associated with soil remediation projects.

2. Have a basic working knowledge of state and federal occupational safety and health regulations.

3. Have formal education and/or training in occupational safety and health.

B. Health and Safety Officer Responsibilities:

1. Obligated to stop or start the work when it is necessary or advisable for reasons of health or safety.

2. Completing daily health and safety training sessions (i.e. "tailgate meetings").

3. Implementing and daily enforcement and monitoring of the site-specific HASP.

4. Be on the site during the execution of Work at the site.

2.2 PERSONNEL HEALTH, SAFETY, AND HYGIENE

A. Medical Surveillance: Conduct medical surveillance of personnel as required by 29 CFR 1910.120, 29 CFR 1926.65, and 29 CFR 1910.134.

B. Training: Furnish personnel assigned to or entering the site who have successfully completed training required by the applicable OSHA Standards in 29 CFR 1910 and 29 CFR 1926 and specifically with 29 CFR 1910.120 and 1926.65.

C. Levels of Protection: Establish actual levels of protection for each task based on planned activity and location of activity.

D. Personal Protective Equipment (PPE):

1. Furnish on-site Contractor personnel with appropriate PPE. Clean and maintain safety equipment and protective clothing. As a minimum, each worker on-site shall wear a hard hat, safety glasses with side shields, safety boots with steel toes and shank, and full-length pants.

2. Develop protective equipment usage procedures and enforce strict compliance with such procedures by on-site personnel.

E. Respiratory Protection

1. Furnish on-site personnel with training in the usage and limitations of, and qualitative fit testing for, air purifying and supplied-air respirators in accordance with 29 CFR 1910.134.

2. Develop, implement, and maintain a written respiratory program in accordance with 29 CFR 1910.134.

3. Monitor, evaluate, and provide respiratory protection for on-site personnel, as appropriate.

4. Immediately notify RMC if level of respiratory protection required increases from Level D to Level C.

F. Heat Stress/Cold Stress: Implement a heat stress and/or cold stress monitoring program as applicable and include in the site-specific Health and Safety Plan.

G. Personnel Hygiene and Personnel Decontamination Procedures.

1. Provide, as a minimum, the following:

   a. Suitable containers for storage and disposal of used disposable PPE.

   b. Potable water and a suitable sanitation facility.

H. Emergency and First-Aid Equipment

1. Locate and maintain emergency and first-aid equipment in appropriate location on the site, including:

   a. First-Aid kit to accommodate the number of on-site personnel.

   b. ABC type dry chemical fire extinguishers.

2. As a minimum, provide one (1) certified first-aid technician on the site at all times when on-site work activities are in progress. This technician may perform other duties but shall be immediately available to render first aid when needed.

I. Site Communications:

1. Post emergency numbers near the site telephones.

2. Furnish selected personnel with 2-way radios.

J. Safety Meetings: Conduct mandatory daily safety meetings for on-site personnel, and additionally as required by special or work-related conditions; include refresher training for existing equipment and protocols, review ongoing safety issues and protocols, and examine new site conditions as they are encountered. Hold additional safety meetings on an as-needed basis.

K. The Contractor shall be responsible for keeping safety equipment and facilities clean, properly equipped, and maintained. The Health and Safety Officer may perform other duties for Contractor but the first priority shall be maintenance of protective equipment and the personnel decontamination area.

2.3 AIR MONITORING

A. The Contractor shall develop an air monitoring program meeting the requirements of 29 CFR 1910.120 (h) and 29 CFR 1926.65 (h).

B. The Contractor shall monitor the progress of work activities, monitor air quality in and around the exclusion zone. The Contractor shall conduct all required air monitoring.

C. The Contractor shall provide the required instruments for air monitoring including, but not limited to, as a minimum:

1. Dust monitor (mini Ram or equivalent).
2. High-Volume Air Monitors

D. The Contractor shall operate air monitoring equipment with personnel trained in the use of the specific equipment provided under direct control of the Contractor's health and safety officer.

E. The Contractor shall conduct all required air monitoring during the Work of the Contract.

2.4 SITE CONTROL

A. The Contractor shall comply with 29 CFR 1910.120 (d) and 20 CFR 1926.65 (d).

B. The Contractor shall provide in the HASP a figure or map which presents the delineation of the work zones for Project activities considered in the Work of the Contract.

C. The Contractor shall provide in the HASP a discussion on Site security issues.

D. The Contractor shall provide in the HASP a detailed discussion on decontamination procedures for both equipment and personnel, including collection and disposal of wash waters and spent PPE.

PART 3: EXECUTION

3.1 HEALTH AND SAFETY PLAN

A. The Contractor shall prepare a written Health and Safety Plan which is applicable to all components of the Work. The HASP shall be based upon the requirements and guidelines described herein and all provisions of applicable law. The Contractor's HASP will apply to all personnel on-site including the Contractor and its subcontractors, RMC and its representatives, the property owners, the USEPA, the IDEM and other regulatory agencies. The Contractor shall include additional information as appropriate and may utilize any format provided it is neat, clean and complete.

B. The Contractor shall ensure that the HASP meets, at a minimum, the requirements of OSHA Standards and Regulations contained in Title 29, Code of Federal Regulations, Parts 1910 and 1926 (29 CFR 1910 and 1926).

C. In addition, the Contractor's HASP must include at a minimum, the following information:

- Responsibilities of the Contractor and its Health and Safety Officer and the name of the Health and Safety Officer and assistant health and safety personnel to be utilized on site.
- A description of the Work to be performed at the Site and how health and safety activities are related to the work.
- A hazard evaluation, including discussions of potential hazards involved with the Work.
- A discussion of proposed environmental and personnel monitoring including specific types of equipment to be used and action levels to be instituted.
- Personnel protection requirements for specific work areas, specific activities or specific tasks. The Contractor shall supply all personal protective equipment.
- Personnel and equipment decontamination procedures.

- Training requirements for personnel utilizing personal protective equipment. The Contractor shall provide 40 hours of classroom training supplemented with site-specific training as required by OSHA in 29 CFR 1910.120 for all personnel who will be working on-site prior to their initiating on-site work. Additionally, the Contractor's supervisory personnel shall receive an additional 8 hours of supervisory training.

- Daily and weekly safety logs and a closeout safety report to be prepared by the Contractor.

3.2 IMPLEMENTATION OF PLAN

A. Once the Health and Safety Plan (HASP) has been accepted by RMC, the USEPA and the IDEM, then the requirements of the HASP shall be enforced and the Contractor shall commence the remediation activities.

B. The Contractor shall provide an on-site Health and Safety Officer during all Work activities, appropriately trained and certified for supervisory responsibility in health and safety protection. An alternate Health and Safety Officer, with appropriate training, must be designated to serve when the Health and Safety Officer is not on-site.

C. It shall be the responsibility of the Contractor's Health and Safety Officer to ensure that all health and safety requirements are implemented per the approved HASP.

D The Contractor's Health and Safety Officer shall be responsible for personnel decontamination and emergency response measures.

E. The Contractor's Health and Safety Officer shall have the authority to act on all health and safety issues and matters, and to establish new controls, procedures or facilities as needed.

END OF SECTION

SECTION 01355

WASTE MANAGEMENT AND DISPOSAL PLAN REQUIREMENTS

PART 1: GENERAL

1.1 DESCRIPTION

The proposed Work is not expected to generate a significant volume of waste materials requiring offsite disposal or recycling. The only anticipated waste materials requiring off-site management will be minor amounts of scrap metal destined for recycling, general refuse generated by the temporary office facilities and materials generated during the clearing and grubbing process. Depending on the amount of impacted soil excavated and the ultimate capacity of the containment cell, off-site disposal of some soil/sediment/debris may be required.

1.2 RELATED SECTIONS

A. Section 01300 - Submittals

B. Section 01351 - Health and Safety Plan Requirements

C. Section 02110 – Site Clearing and Grubbing

D. Section 02150 – Demolition of Remnant Structures

E. Section 02209 - Excavation/Handling/Placement

1.3 SUBMITTALS

The Contractor shall submit for RMC approval the names and permit information for all proposed disposal or recycling facilities. Submittal shall include copies of current operating permits and proof of insurance for the facility and the name and contact information of regulatory inspectors.

PART 2: PRODUCTS

2.1 WASTE STORAGE AND SHIPPING CONTAINERS

A. The Contractor's containers utilized to store and transport the various waste materials shall be appropriately sized and compatible with the material being managed and approved for the intended use by the Department of Transportation.

PART 3: EXECUTION

3.1 GENERAL

A. Soil, sediment and miscellaneous debris generated during the remedial activities will be placed in the Containment Cell in accordance with the procedures contained in Specification Section 02209.

B. Only materials approved by the QA Representative will be released for off-site management.

C. The proposed corrective measures will require the removal of more than 2,000 cy of concrete pavement, floor slabs and wall (excluding the MSB floor). It is the intent of RMC as part of its "Green Remediation" efforts to segregate, crush and reuse the concrete. Specific information to the procedures related to the segregation, crushing and recycling are provided in Section 02150. If concrete can not be recycled because it fails analytical requirements established in the Specifications for re-use it shall be disposed in the Containment Cell.

D. The Contractor's submittals for proposed off-site recycling or disposal facilities shall include:

1. Characterization sampling required by each facility for each type of waste and the name and qualifications of the laboratory to provide the required analysis.

2. Waste management requirements for each waste stream including labeling, manifests and bills of lading, and record keeping.

3. Name, address, telephone number, contact name, copy of operating permits and proof of insurance for each proposed disposal facility.

4. Names, address, telephone numbers, contact name, copy of operating permits and proof of insurance for each proposed transporter.

5. Description of transportation operations for each waste material.

3.2 PREVIOUSLY UTILIZED DISPOSAL AND RECYCLING FACILITIES

During the decontamination and demolition activities, the following facilities were utilized:

1. Metals Recycling – OmniSource
2. Non-Hazardous Solid Waste – Southside Landfill Inc.
3. Hazardous Solid Waste – Heritage Environmental Services

END OF SECTION

SECTION 01400

QUALITY ASSURANCE/QUALITY CONTROL

PART 1: GENERAL

1.1 DESCRIPTION

A. Work Included:

The Contractor shall establish and maintain a project specific Quality Control (QC) and management program (collectively QC program) for each component to be furnished and installed under the Contract Documents. Contractor shall have the "primary" responsibility for the quality of all its work and ensure that all materials meet the requirements established in these Specifications.

B. RMC will provide a full-time Quality Assurance Representative (QA Representative) to observe and document work activities and the Contractor's QC program. The Contractor shall be responsible for the implementation QC requirements of the Corrective Measures Design. The Contractor shall not rely on RMC's QA Representative to satisfy the requirements of these Specifications, except as it relates to the collection and analysis of post-excavation samples, which will be performed by the QA Representative.

1.2 RELATED SECTIONS

A. Section 01010 - Summary of Work

B. Section 01050 - Field Engineering

C. Section 02209 – Excavation/Handling/Placement

D. Section 01300 – Submittals

E. Section 02210 – Earthwork

F. Section 02751 – Cap Drainage Layer

G. Section 02755 – Cap Barrier Layer

H. Section 02936 - Site Restoration

1.3 DEFINITIONS

The following definitions pertain to requirements of this Section.

A. Quality Assurance (QA):

Quality Assurance is a planned and systematic pattern of activities (for example, approved surveillance and audit requirements) designed to assure and document that the Quality Control (QC) of items or procedures are being performed in accordance with the approved remedial design and that the product of the construction will perform satisfactory in service and will meet the highest quality standards. This Section also provides a methodology for resolving problems which may occur during construction. The Construction Quality Assurance Plan (CQAP) outlines the procedures and requirements for QA.

B. Quality Control (QC):

Quality Control is defined as those actions taken by manufacturers, fabricators, installers and contractors that provide a means (for example, through examining, witnessing, inspecting, checking and testing of in-process or completed work) to measure performance and to demonstrate that the characteristics of an item or service meet the contractual and regulatory requirements, as well as to document the results. Specific QC procedures and requirements are outlined in these Specifications. The Contractor performs Quality Control.

1.4 SUBMITTALS

A. The Contractor shall submit the names and qualifications of the personnel retained by the Contractor to conduct Quality Control activities. At a minimum this is expected to include geotechnical engineering testing services (i.e. compaction testing) and geomembrane installation quality control. If the geomembrane installation QC is conducted by the liner installer, the qualification of the installers QC representative shall be submitted with the liner installer company's qualifications.

1.5 SITE QUALITY CONTROL

A. The Contractor shall identify an individual within its organization at the site of the Work, who shall be responsible for overall management of Quality Control.

B. Material arriving at the site shall be inspected and documented to conform to the Contract requirements. Nonconforming and damaged material shall be segregated and removed from the site.

C. The Contractor shall protect all materials and equipment from rust, corrosion and similar damage.

D. The Contractor shall, as soon as the material arrives at site (but before beginning installation), provide to RMC the original bill of lading and required certifications stating that the material complies with the requirements of the Contract Documents.

E. The Contractor shall perform necessary and specified tests as received and shall document the results. The Contractor shall replace material that fails the tests.

F. Remove and replace new or existing material that is damaged in storage or in the performance of Work unless specifically accepted in writing by QA Representative.

G. No Work shall be performed at the Site if the Contractor's Superintendent, or his designee, is not present at the site.

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

3.1 DATA MANAGEMENT AND DOCUMENTATION

A. General

The Contractor will be responsible for documenting that the quality control requirements of this project have been addressed and satisfied. The Contractor will be responsible for ensuring that the quality control documentation is complete and accurate with adequate documentation.

The Contractor's QC reporting will include descriptive remarks, data sheets, and logs to verify that the monitoring activities have been carried out in accordance with the Specifications and Construction Quality Control Plan. Performance standards established for the project will need to be demonstrated. The

Contractor will also maintain at the job site a complete file of plans and specifications, the Contractor HASP, the Contractor's checklists, test procedures, daily logs, and other pertinent materials that will be used to document conformance with the approved design drawings and specifications for this project.

The Contractor will prepare progress logs and test data sheets daily, as appropriate and provide such information as attachments to the Daily Field Reports. At a minimum, these reports will include the following information:

- Descriptions and locations of ongoing construction;
- Data on weather conditions;
- Equipment and personnel in each work area, including subcontractors;
- Descriptions and specific locations of areas, or units, or work being completed, tested and/or observed and documented;
- Locations where any tests and samples were taken; and a summary of tests results;
- Calibrations or recalibrations of test equipment, and actions taken as a result of recalibration;
- Delivery schedule of relevant construction materials received, including quality control documentation for appropriate materials;
- Decisions made regarding acceptance of units of work, and/or corrective actions to be taken in instances of substandard quality; and,
- Signature.

The QA Representative will be made aware of any significant recurring non-conformance. The QA Representative will work with the Contractor to determine the cause of the non-conformance and recommend appropriate changes, such as revisions to procedures or specifications.

B. Design and/or Specification Changes

Design and/or specification changes may be required during construction. In such cases, the Contractor will notify RMC, who will coordinate with the Engineer regarding the nature of and reasons for the required change. Design and/or specification changes will be made only with the written agreement of RMC (following review and consultation with all appropriate parties such as the Engineer, USEPA and IDEM), and, if necessary, will take the form of an addendum to the Corrective Measures Design.

C. Contractor's Final-QC Report

At the completion of the Work, the Contractor's Project Manager will submit to RMC a final QC report. This report will include:

- A certification that the Work has been performed in compliance with the Corrective Measures Design
- Physical sampling and testing have been conducted at the appropriate frequencies;
- Observation logs and testing data sheets including the Contractor's sample location plans; and
- As-Built drawings (See Section 01050).

END OF SECTION

SECTION 01500

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1: GENERAL

1.1 DESCRIPTION

A. Work included:

The Contractor shall provide temporary facilities and controls needed for the performance of its Work including, but not necessarily limited to:

1. Temporary utilities such as water, electricity, and telephone;
2. Field office for the Contractor's personnel;
3. Sanitary facilities;
4. Enclosures such as tarpaulins, barricades and canopies;
5. First-aid facilities;
6. Temporary fencing and other safety devices for pedestrian and vehicular traffic as well as isolating the construction area;
7. Entry Control limiting access to authorized construction personnel;
8. Dust and Pollution Control and Monitoring Equipment;
9. Erosion and Sediment Control;
10. Water Control;
11. Health and Safety measures as required by the Contractors approved Health and Safety Plan;
12. Creation and maintenance of access roads.

1.2 RELATED SECTIONS

A. Section 01010 - Summary of Work

B. Section 01300 - Submittals

C. Section 01351 – Health and Safety Plan Requirements

D. Division 2 of these Specifications

1.3 SUBMITTALS

A. The Contractor shall provide a plan showing the proposed layout for the temporary facilities for review and approval by RMC prior to start of mobilization.

1.4 PRODUCT HANDLING

The Contractor shall maintain and protect all temporary facilities and controls in proper and safe condition throughout progress of the Work.

1.5 TEMPORARY UTILITIES AND SERVICES

A. Water: Water lines are in place and operable up to the fire hydrant situated near pump house #4, although service has been discontinued. In order to perform the Work of the Contract, the Contractor shall be responsible for restoration of water service to the site prior to commencement of remedial activities and shall be responsible for discontinuation of water service following successful completion of remedial activities. The Contractor shall absorb all costs associated with water service restoration and cancelation, and the costs of the water usage during any phase of the Work of the Contract.

The Contractor shall also provide, maintain, and pay for potable water (e.g., bottled water) for each of the Contractor supplied office trailers and for all work personnel.

B. Sanitary Facilities:

1. The Contractor shall provide, and pay for all portable sanitary accommodations for all Contractor personnel on the project, including RMC representatives, and regulatory agencies. Facilities shall be located

in areas convenient to personnel and approved by RMC. The Contractor is to provide at least one portable sanitary unit per trailer and one unit shall be provided for every fifteen (15) employees of the Contractor. The units shall be cleaned and maintained by the Contractor in a sanitary condition and at a minimum frequency of twice per week.

C. Temporary Power and Lighting:

1. The Contractor shall provide all temporary electricity necessary to complete the Work as detailed in the Specifications and on the design drawings. The Contractor may connect to local electrical sources or may provide on-site generators; however, the temporary electrical supply method must be approved by RMC and must also meet federal, state, and local regulations. The Contractor's electrical service shall not be subject to voltage fluctuations capable of damaging electrical equipment.

2. The Contractor shall provide temporary lighting for the support (i.e., trailers), access, parking, and active work areas. The provision of lighting in the active work areas does not necessarily permit the Contractor to work after sunset without the prior written approval of RMC and the Engineer.

3. The Contractor shall pay all costs associated with the utility tie-ins, physical plant, maintenance of system throughout construction, power usage during the work, removal of same at project completion and any other items necessary in providing temporary power and light. The temporary power and lighting system shall at all times conform with the applicable codes and regulations of OSHA, NEMA, UL, and the local municipality.

D. Telephones:

1. The Contractor shall make necessary arrangements and pay costs for installation, maintenance and operation of direct line (non pay type) telephone services in the Contractor's field office at the site. Telephone service in main office trailer shall be suitable for conferencing during weekly progress calls.

1.6 ACCESS, STORAGE AND PARKING AREAS

A. The Contractor shall establish a construction Compound. The Contractor shall submit to RMC a plan layout of the Compound for RMC approval prior to mobilization.

B. The Contractor shall coordinate the provision of utility services for all trailers and be responsible for all installation charges, removal costs at Project completion, and any periodic or other charges incidental to the provision of those utility services.

C. Contractor shall provide lighting for the Contractor compound areas.

D. Routes of ingress and egress within the Site shall be clearly marked and protected by the Contractor as required by the Section 02100. Temporary roads to the construction areas shall be constructed and maintained by the Contractor. These roads may be extended and relocated as Work progresses, as long as traffic flow is unimpeded. The Contractor shall maintain both access and temporary construction roads in adequate condition such that vehicular and pedestrian traffic can safely and easily negotiate the roads. Conditions which should be corrected by the Contractor shall include, but are not be limited to, excessive ponding water, excessive dust generation, potholes, or excessive mud, snow, or debris. All access and temporary construction roads shall be removed and restored

E. Upon final acceptance of the Work, the Contractor shall clean up the work areas and leave them in a neat and orderly condition. The Contractor shall dismantle and remove all temporary fencing and barricades and other temporary items installed, unless otherwise directed by RMC. Repair damaged areas to their original condition.

1.7 FIELD OFFICES AND SHEDS

A. Contractor's Field Office:

Furnish and maintain a field office with a telephone at the site during the entire period of construction. Keep readily accessible at the field office copies of both the Contract Documents and the latest approved shop and working drawings.

B. RMC's Field Offices

The Contractor shall provide at least 100 sf of field office space for use by RMC's on-site representatives. Such space may be located in the same trailer as the Contractor's field office but must include a lockable door, desk surface with at least one 2-drawer file cabinet and two chairs.

1.8 ENCLOSURES AND TEMPORARY FENCING

A. The Contractor shall provide all storage necessary for materials and equipment associated with the Work, as specified in individual specification sections and as recommended by the respective manufacturers. Protection for materials, equipment, and completed Work shall be provided by the Contractor in addition to any special protection where specified in individual specification sections.

1.9 TEMPORARY SIGNAGE (CONSTRUCTION)

A. The Contractor shall provide, maintain, and pay for all barricades, temporary fencing, railings, warning lighting, signage and other similar items necessary to protect all areas required and to comply with OSHA guidelines for safe working environments for both site personnel and onlookers and to prevent unauthorized entry onto the Site or work zones.

1.10 PROTECTION OF NEW AND EXISITNG IMPROVEMENTS

A. The Contractor shall protect all areas on and off the Site that may be damaged by its activities. This shall include, but not be limited to, streets, roads, monitoring wells, Site entrances, existing fence and gates, railroad right-of-ways, existing drainage features, adjacent properties, previous site improvements, sidewalks, utilities, trees, plants, lawns or other maintained areas. The Contractor shall also protect all off-site and clean on-site areas from cross-contamination by vehicular tracking, erosion, or any other mechanism, manmade or natural. Any areas or items that are impacted by the Contractor's activities shall be repaired or replaced at the Contractor's expense.

B. Temporary and removable protection shall also be provided, as necessary. The Contractor shall control activity in the immediate work area to prevent damage or contamination. Traffic should be prohibited from completed or protected areas. Any damage to materials, equipment or completed Work shall be repaired or replaced at the Contractor's expense. The Contractor shall delineate work zones using temporary orange snow fence and posts with warning signs as approved by RMC and the Engineer.

1.11 POLLUTION AND DUST CONTROL

A. The Contractor shall supply all expertise, labor, equipment, and materials necessary to control the spread of contamination and to control the generation of excessive noise, dust or odor emissions. Dust control shall be conducted in order to maintain all work areas free from dust which would contribute to air pollution. Approved temporary methods of dust control consisting of sprinkling, water treatment, or similar methods will be permitted. Sprinkling, where used, must be repeated at such intervals as to keep all parts of the disturbed area at least damp at all times. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs.

B. The Contractor shall provide and maintain decontamination stations for the proper decontamination of all equipment, personnel, and materials leaving a contaminated work zone. This includes, but is not limited to, all pumps, power washers, storage tanks and Contaminant Reduction Zone.

C. The Contractor shall provide all necessary expertise, supervision, labor, materials, and equipment and shall perform all work activities in such a manner as to minimize the amount of noise, dust, or odor generated from the Site. The Contractor shall also ensure that the levels of noise, dust, and odor and methods of mitigating them are in accordance with federal, state and local regulations.

1.12 EROSION AND SEDIMENT CONTROL

A. The Contractor shall provide Erosion and Sediment controls as required by the Corrective Measures Design to protect the Site from erosion and to prevent contaminated particles from exiting the Site.

1.13 WATER CONTROL

A. The Contractor shall provide water control throughout the duration of the Contract in accordance with the Water Management During Construction Section 02715.

1.14 SECURITY

A. The Contractor shall be responsible for maintaining existing security fencing and gates for adequate protection of and restriction of access to all areas of the site, including support zones and active/inactive work areas, by unauthorized persons or vehicles throughout the Work. Security fence maintenance shall protect the Work and existing facilities from unauthorized entry, vandalism, or theft.

B. The Contractor shall be solely responsible for security of its equipment and work. RMC currently maintains a part-time security service consisting of one to three site visits by an unarmed guard between dusk and dawn. RMC does not maintain responsibility for protection of Contractor equipment, materials, or completed work.

1.15 PROGRESS CLEANING

A. The Contractor shall incorporate a cleaning program for the support facility and work areas of the Site on a periodic basis. The cleaning methods and frequency shall be adequate to maintain all areas of the Site, including maintaining the interior of trailers free of waste materials, debris, and rubbish, and generally safe, clean, organized and workable. Upon final acceptance of the Work, the Contractor shall clean up the work area and leave it in a neat and orderly condition.

B. The Contractor shall provide trash service involving at least one eight (8) cubic yard dumpster to be emptied once a week. The Contractor may need to provide more extensive trash collection measures during peak periods of construction so that the dumpster is not overflowing at any point in time.

1.16 FIRE PREVENTION CONTROL

A. The Contractor shall take all precautions necessary to prevent fires and explosions. All open flame, welding, and heating operations shall be performed in accordance with OSHA standards. The Contractor shall provide and maintain dry chemical type fire extinguishers in the immediate vicinity of any flame or spark producing operations and also in each of the office trailers. All flammable liquids shall be stored in accordance with OSHA standards. Gasoline shall be transported and stored in OSHA approved containers only.

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

Not Used.

END OF SECTION

SPECIFICATIONS

DIVISION 2

SPECIFICATIONS

DIVISION 2

SECTION 02100

SITE PREPARATION

PART 1: GENERAL

1.1 DESCRIPTION OF WORK

At the initiation of the Work, the Contractor will perform a variety of tasks that are necessary to prepare the proposed work areas, control access and traffic patterns, provide storm water management and erosion control, and prevent cross-contamination. Site preparation activities will include establishment of the various zones, security fence, utility location and abandonment, clearing and grubbing, installation of erosion control measures, implementation of dust control measures and air monitoring, mobilization and activation of temporary water treatment equipment and stake-out of proposed work areas.

1.2 RELATED SECTIONS

A. Section 01010 - Summary of Work

B. Section 01050 - Field Engineering

C. Section 01351 - Health and Safety Plan Requirements

D. Section 01500 - Construction Facilities and Temporary Controls

E. Section 02110 - Site Clearing and Grubbing

F. Section 02115 - Erosion and Sediment Control Measures

G. Section 02209 - Excavation/Handling/Placement

H. Section 02715 - Water Management During Construction

I. Section 02936 - Restoration

J. Section 02999 - Dust Control and Air Monitoring

1.3 QUALITY ASSURANCE

The QA Representative shall field check stake-out and grade controls established by the Contractor's Surveyor for the proposed soil removal limits and evaluate the adequacy of erosion control measures prior to beginning excavation activities. QA Representative shall also confirm that the measures required as part of this Section are fully installed and functional prior to initiation of work. Site preparation activities may be sequenced based on the Contractor's means and methods, provided necessary measures are fully operational as determined by the QA Representative. All products must meet specific parameters contained in these Specifications. If deemed necessary by the USEPA, IDEM, or RMC, additional measures (such as erosion and sediment control, construction safety fences, drainage control measures, etc.) will be added, and/or materials not meeting the requirements of the Specifications will be removed by the Contractor.

1.4 SUBMITTALS

A. Prior to initiating any on-site activities, the Contractor shall have received final acceptance of the Contractor's Health and Safety Plan (Section 01351) by the USEPA, IDEM and RMC.

B. Contractor shall have received written approval of the submittals required for site preparation activities (including erosion and sediment control products Section 02115) and all subcontractors. RMC will not be responsible for delays or costs associated with the Contractor's failure to make required submittals or provide acceptable materials and qualified subcontractors.

C. If the Contractor chooses to establish temporary facilities and/or controls differing from those presented on Sheet 4 of the design drawings, he shall present the alternate layout on a markup of Sheet 4 for approval by RMC prior to commencing mobilization. All field offices, equipment and employee parking, material storage and sanitary facilities must be located on the RMC property unless explicit written authorization is obtained by the Contractor from the property owner and the Contractor can demonstrate to RMC, USEPA and IDEM that location of such facilities at the proposed alternate location will not cause adverse environmental impacts or potential health and safety hazard. The only temporary facilities that are anticipated to be situated on non-RMC property are erosion control and safety measures, pumps and piping for transferring storm water to the temporary treatment system on the RMC property, and temporary loading and decontamination stations.

PART 2: PRODUCTS

2.1 CONSTRUCTION SAFETY FENCE

A. Temporary Construction Safety Fence – Construction safety fence shall be 48-inches high, orange plastic safety fence. Contractor may re-use construction safety fence for the project provided the fence maintains its original strength and durability.

B. Metal T-Posts – Posts utilized for temporary construction safety fence shall be metal T-posts having a minimum length of 60-inches. If reinforcing steel or similar steel rods are utilized as fence posts the Contractor shall provide and maintain protective caps on all such post. T-posts do not require protective caps.

2.2 CONTAMINANT REDUCTION ZONES

A. CRZ Coarse Aggregate

Coarse aggregate used for the vehicular Contaminant Reduction Zones (CRZ) shall be clean hard durable stone matching AASHTO No. 1 size requirements. The stone shall be of such quality that it will not disintegrate on exposure to water or weathering.

B. CRZ Filter Fabric

The Vehicular CRZ shall be underlain by a non-woven geotextile filter fabric material possessing a minimum grab strength of 200 lbs/in and minimum puncture strength of 90 lbs.

2.3 EROSION AND SEDIMENT CONTROL

A. Erosion and Sediment Control measures shall meet the requirements established in Section 02115 of the Specifications.

2.4 SITE SECURITY FENCE

A. Permanent Site Security Fence shall meet the requirements established in Section 02831 of the Specifications.

PART 3: EXECUTION

3.1 FAMILIARIZATION

A. The Contractor's superintendent will participate in a site walk with the QA Representative prior to the commencement of site preparation activities. Representatives from the USEPA and IDEM will also be invited to participate in the site walk. The site walk will be intended to familiarize the superintendent with beginning conditions and RMC's expectations for the project. During the site walk, site conditions will be reviewed relative to the Contractor's proposed employee parking areas, support zones, material and equipment staging areas, exclusion zones, and vehicle and personnel decontamination stations. Minor modifications in the location or configuration may be made based on the conditions observed as agreed to by RMC.

3.2 ESTABLISHMENT OF DESIGNATED ZONES

A. Support Zone (SZ) - The Contractor shall establish a Support Zone for staging of construction equipment, and materials and products brought to the site. The SZ must be located outside of the Exclusion Zone and Contaminant Reduction Zone. The support zone shall be adequately sized to facilitate staging of equipment and to take delivery of materials. The support zone shall be situated on-site such that traffic routes and excavation areas are not impeded. Any fuel storage shall be located within the support zone and the Contractor shall implement proper spill containment.

B. Contaminant Reduction Zones – The Contractor shall provide Contaminant Reduction Zones (CRZ) at designated locations where the equipment and personnel will be transitioning from the exclusion zones to the support zones. The CRZs will provide facilities for workers to don and remove work boots and pads for removing potentially contaminated soil from the wheels/tracks and frames of vehicles. The Contractor's Site Health and Safety Plan will provide specific information regarding the specific configuration and facilities to be provided. Sheet 4 shows one primary CRZ location (near the former battery breaker) and one short term CRZ location for use during cleanout and closure of the lagoon. These locations have been selected to remain usable for as long as possible based on the assumed sequence of construction. The locations of the CRZ may shift during the course of the work depending on the means and methods to be employed by the selected Contractor. Alternate locations must be pre-approved by the Engineer. Additionally, as detailed in Section 02209, work along the driveway, South Arlington Avenue and the railroad right-of-ways is expected to proceed rapidly and is expected to be performed using techniques for excavation and vehicular loading that will not require entry into the work zone except by the excavator bucket and workers. Therefore, only temporary CRZ facilities will be required for personnel and hand equipment.

C. Exclusion Zone – Prior to the start of intrusive construction activities, the Contractor will clearly mark the limits of proposed remediation, as presented on sheet 4 of the Design Drawings, unless otherwise approved by the Engineer to accommodate the Contractor's proposed means and methods. Personnel and equipment entering and exiting the Exclusion Zone (EZ) will be required to pass through the CRZ. The Contractor shall reduce the area of the exclusion zone as work progresses to protect remediated areas from possible recontamination. The work within the right-of-way along Arlington Avenue will be protected on one side by the existing fence along the RMC property line and on the opposite side by the traffic control devices required as part of the highway occupancy permit. Construction safety fence shall function as a temporary EZ fence to protect open excavation areas during non-working hours.

3.3 UTILITY LOCATION AND ABANDONMENT

A. The Contractor is responsible for the identification and protection of utilities at the site and all off-site work zones. The Contractor is required to perform notifications utilizing the Indiana One-Call for location of public utilities and to engage a private utility locator to clear excavation areas for utilities. Known utilities include water and natural gas that enters the site from South Arlington Avenue; water service that enters the site from Big Four Road; sanitary sewer service entering the site from South Arlington Avenue; water, gas and telecommunications (including fiber optic cable) in the right-of-way of South Arlington Avenue; fiber optic cables in the railroad right of ways, natural gas lines from Big Four Road to Citizens Gas; and overhead power and communications lines.

B. Electrical service will be required to maintain operation of the storm water pump houses until completion of remediation and regrading of the site to provide drainage as described in Section 02715 at which time the pump houses will be demolished. The Contractor will be responsible for disconnecting power between the pump houses and the Indiana Power and Light (IPL) poles. If power is disconnected before use of the pump houses is completed, the Contractor shall provide temporary power connection until the pump houses are no longer required.

C. The sanitary sewer enters from South Arlington Avenue at the northeast corner of the property. Following cessation of plant operations, the sanitary sewer has been used exclusively for discharge of storm water to the POTW. RMC plans to submit a Special Discharge Application to the City of Indianapolis to allow discharge of treated decontamination water and water from active work zones, during Corrective Measures and Closure activities. Therefore, the sanitary sewer must be protected until completion of remedial activities or temporarily re-piped to maintain discharge.

D. The Design Drawings indicate several groundwater monitoring wells and a former Production Well that must be abandoned. Abandonment will be completed by RMC prior to/or at the start of Corrective Measures activities.

3.4 CLEARING AND GRUBBING

A. Clearing and grubbing is required to accommodate the proposed containment cell and allow access for remediation. Clearing and grubbing may not commence until the site preparation activities protecting or servicing the area to be cleared are installed. Clearing and grubbing requirements are provided in Section 02110.

3.5 PROJECT STAKE-OUT

A. The Contractor's surveyor shall field locate the proposed limits of soil and sediment removal and the containment cell utilizing the horizontal controls identified on the Design Drawings. For control purposes the Contractor's surveyor will establish a reproducible reference grid (and/or cross-sections) in the excavation areas and containment cell to document starting ground surface elevations.

B. Proposed excavation depths are presented on Sheets 6, 7 and 8 of the Design Drawings. Actual excavation depth will be measured relative to starting ground surface utilizing the reference grid established by the Contractor's survey. The Contractor may perform his own measurements of excavation depths utilizing the grid and cross-sections established by his Professional Surveyor utilizing survey equipment and techniques approved by the QA Representative. However, the Contractor is responsible for the accuracy of such measurements. The Contractor will not be compensated for over-excavation not pre-approved by RMC. The Contractor will also be responsible for costs associated with off-site disposal of such over-excavated material if it can not be accommodated in the Containment Cell.

3.6 EROSION AND SEDIMENT CONTROL

A. Contractor shall install erosion and sediment control measures (silt fence and stabilized construction entrances) as required by Section 02115 of the Specifications and as directed by RMC during the course of the work. When field conditions prohibit the installation of erosion and sediment control devices (such as for the conflict with a utility), erosion and sediment control shall be achieved through sequencing and excavation management.

3.7 TRAFFIC PATTERNS

A. The Contractor is required to implement a sequence for construction and traffic patterns for construction equipment that protects site workers and public and prevents cross-contamination. Routes within the support zones shall be confined to existing surfaces to the extent possible and delineated during site preparation activities using cones, barriers, and/or markings. Routes within the exclusion zone shall be established to avoid tracking across areas of completed remediation, prevent rutting and the generation of dust.

B. The contractor shall install an access ramp into the containment cell suitable for the construction equipment being utilized. This is expected to include a combination of geotextile fabric and crushed aggregate or recycled concrete as described for construction entrances in Section 02115. The temporary access ramp shall be maintained during the period of containment cell filling. At the end of filling, the access ramp shall be removed.

3.8 CONTAMINANT REDUCTION ZONES

A. Contaminant Reduction Zones (CRZs) for vehicles exiting the the exclusion zone shall be established at the locations shown on Sheet 4 and at other locations as approved by RMC, USEPA and IDEM. CRZs shall be appropriately sized to accommodate the size and weight of construction equipment proposed for use by the Contractor but no less than 14 feet wide by 40 feet long.

B. The CRZ shall be constructed in accordance with the detail provided on Sheet 12 of the design drawings. If the CRZ is constructed on an impervious surface, the contractor shall provide measures to collect decontamination water for transfer to and processing through the temporary treatment system or direct the water into incomplete remediation areas where it will be allowed to infiltrate. On pervious surfaces the water will be allowed to infiltrate. The proposed geotextile fabric will filter the water to remove soil and sediment washed into the stone.

C. The Contractor will be required to maintain and operate the CRZ throughout the period of use. Operation will include driving vehicles from the exclusion zone onto the CRZ and cleaning the equipment, including the wheels and under carriage, using hand tools and pressures washers, or other techniques as approved by the QA Representative. Depending on the Contractor's proposed sequence of work, the CRZ may be moved/relocated as approved by the QA Representative. If the CRZ becomes clogged or is otherwise incapable of handling water created during decontamination activities or precipitation the Contractor will be required to clean out the clogged stone and or fabric and replace with clean material. Removed materials will be disposed in the Containment cell.

3.9 TEMPORARY CONSTRUCTION SAFETY FENCE

A. Temporary construction safety fence will be placed along the limits of the work zone during non-working hours in those areas outside the site security fence to provide a high visibility demarcation between the work zones and surrounding areas, and prevent access by the general public. The alignment of the temporary construction safety fence will be established in the field but shall be situated outside the remediation areas.

B. Construction safety fence shall be supported using T-posts at a maximum spacing of 10-feet on-center. T-posts shall be driven into the ground a minimum depth of 12-inches. Safety fence fabric will be fastened to the T-posts using plastic zip ties. Zip ties shall loop through holes in the T-posts. At least 4 zip ties shall be used on each post. The completed fence shall be secure and sufficiently tight to prevent sagging.

3.10 SECURITY FENCE

A. The Contractor is required to extend the security fence along the northern property boundary as part of site preparation activities except to the extent necessary to provide access to drainage ditches along railroad tracks for the purpose of remediation. Sections not completed as part of site preparation will be completed as soon as possible following completion of off-site remediation activities. See Section 02831 for additional requirements.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Work included in this section shall be performed on a lump sum basis and shall, therefore, not be measured. Erosion and sediment control, clearing and grubbing and security fence work will be measured and paid in accordance with the provisions of their relevant Specification Sections

4.2 PAYMENT

PAY ITEM	PAY UNIT PRICE
Site Preparation	Lump Sum

END OF SECTION

SECTION 02110

SITE CLEARING AND GRUBBING

PART 1: GENERAL

1.1 DESCRIPTION

A. The majority of the area proposed for remediation is clear of trees and excessive brush and it is the intent of RMC to preserve and protect mature healthy trees. Where clearing of trees or brush is necessary, it shall be performed in accordance with the procedures described herein and as requested by the QA Representative in the field.

1.2 RELATED SECTIONS

A. Section 02100 – Site Preparation

B. Section 02115 – Erosion and Sediment Control

C. Section 02209 – Excavation/Handling/Placement

D. Section 02210 - Earthwork

E. Section 02936 – Site Restoration

F. Section 02999 – Dust Control and Air Monitoring

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

3.1 GENERAL

A. Erosion and sediment controls shall be implemented prior to site clearing and grubbing as shown on Sheet 4 and required by Section 02115.

B. The Contractor shall collect miscellaneous trash and debris from surface of the Site for off-site disposal as general refuse (miscellaneous concrete and masonry rubble may remain on-site for processing with concrete rubble created during demolition of remnant structures and removal of former concrete floors and foundations). This includes trash and debris in the vicinity of the proposed containment cell.

C. The Contractor's superintendent and QA Representative shall review conditions within those areas proposed for remediation and/or construction of the containment cell, storm water management and storm drainage features and alignment of proposed security fence. At that time, trees greater than 6-inches in diameter (18-inches circumference) as measured at chest height, proposed for removal shall be clearly marked with high visibility paint. Trees to remain and be protected will be flagged using colored tape agreed upon by the superintendent and protected using construction safety fence.

D. The Contractor shall protect benchmarks, monuments, line and grade stakes, other reference points, utility lines or poles, fences, and existing pavement against damage from equipment, vehicular and pedestrian traffic, or clearing activities.

E. The Contractor will coordinate marking of trees not planned for clearing with QA Representative prior to the start of clearing.

3.2 IMPLEMENTATION

A. Grubbing shall be sequenced to minimize the amount of time between disturbance of the ground surface and remediation.

B. Clearing shall consist of the removal and handling of standing trees and snags, stumps, boulders, brush, downed timber, logs and other growth, and other objects on and above the ground surface.

C. Cleared materials shall be promptly moved to a staging area and managed in accordance with sub-section 3.3 of this section.

D. Cleared materials shall be managed to prevent the mixing of contaminated soils with cleared materials. If mixing between contaminated soils and cleared materials does occur, they must be disposed of as contaminated debris at the Contractor's expense.

E. Contractor shall segregate grubbed material generated from within the proposed removal limits from any materials generated outside the remediation limits and manage the material separately.

3.3 HANDLING OF CLEARED MATERIAL

A. Cleared materials from within the limits of the proposed work that are not mixed with soils, shall be considered free of contamination ("Clean Materials') and shall not be handled in a manner that the materials could be contaminated or come in contact with soil in areas to be excavated.

B. Clean Materials shall be ground or chipped to a maximum size of three (3) inches and stockpiled at a location outside the exclusion zone to await shipment off-site. Large diameter lumber may be staged whole and shipped off-site.

C. Grubbed materials from within the limits of the remediation and cleared materials mixed with contaminated soils ("Co-Mingled Material") shall be ground or chipped and placed in a secure location that prevents run-on and run-off of precipitation to await characterization and off-site disposal (non-hazardous) or placement in Containment Cell (hazardous).

D. Trash and other debris shall be sent off-site for disposal as general refuse.

E. On-site burning of the cleared material is not permitted.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Work included in this section shall be performed on a lump sum basis and shall, therefore, not be measured.

4.2 PAYMENT

Payment for clearing shall be based on the lump sum price indicated on the bid form. Off-site disposal of cleared debris shall be paid for on a cubic yard basis.

PAY ITEM	PAY UNIT PRICE
Clearing and Grubbing	Lump Sum
Off-Site Disposal of Clean Material	Cubic Yard
Off-Site Disposal Non-Hazardous Co-Mingled Material	Cubic Yard

END OF SECTION

SECTION 02115

EROSION AND SEDIMENT CONTROL MEASURES

PART 1: GENERAL

1.1 DESCRIPTION

A. The Work covered by this section shall include furnishing, installing, and maintaining all temporary erosion and sediment control measures as required by the specifications and design drawings. This includes, but is not limited to, constructing and operating stabilized construction entrances; restricting site vehicular traffic to designated haul roads; performing watering or other means to prevent the generation of dust; and installing berms, diversions and/or silt fence between work areas. The Contractor shall, on a continuous basis, maintain and repair all existing erosion controls and any additional erosion controls throughout the Work.

B. The quantity and type of erosion control measures shown on the design drawings shall be increased or decreased at the direction of the QA Representative to comply with applicable erosion and sedimentation control regulatory requirements and the intent of the CMD and actual conditions encountered during the Work.

1.2 RELATED SECTIONS

A. Section 01351 - Health and Safety Plan Requirements

B. Section 02100 - Site Preparation

C. Section 02110 - Site Clearing/Grubbing

D. Section 02150 – Demolition of Remnant Structures

E. Section 02209 – Excavation/Handling/Placement

F. Section 02210 – Earthwork

G. Section 02936 – Site Restoration

H. Section 02999 - Dust Control and Air Monitoring

1.3 SUBMITTALS

A. Contractor shall submit manufacturer's information for the products proposed for silt fence fabric, geotextile fabric and temporary seed. Contractor shall also submit representative gradation information and the name, address and IDEM permit number of the quarry for the coarse aggregate proposed for use.

1.4 QUALITY ASSURANCE

A. The QA Representative shall review the Contractor's submittals to ensure that all materials are in accordance with the specification and the CMD. Any material found by QA Representative to be not in conformance with these specifications will be rejected and the Contractor shall remove all such materials from the Site at the Contractor's expense

PART 2: PRODUCTS

2.1 SILT FENCE

A. Silt Fence Geotextile

1. Silt fence geotextile shall be composed of strong, rot-proof synthetic fibers formed into a non-woven fabric. The fabric shall contain stabilizer and/or inhibitors to make the filaments resistant to deterioration resulting from exposure to sunlight or heat. The geotextile shall conform to the requirements shown in Table 1.

TABLE 1
Physical Requirements[1,2]
For Temporary Silt Fence Geotextiles

Property	Test Method	Self Supported Requirements
Grab Tensile Strength Lbs.	ASTM D4632	300 minimum[3]
Elongation at 50% minimum grab tensile strength (45 lbs.)	ASTM D4632	50 maximum
Permittivity[3] (sec^{-1})	ASTM D4491	.01 minimum
Apparent Opening[3] Size (mm) (100 sieve)	ASTM D4751	0.149 maximum
Ultraviolet[4] Degradation	ASTM D4355	Minimum 70% strength retained

NOTES:

1. Geotextile physical properties and a letter from the supplier certifying that its geotextile meets specification requirements shall be submitted to the QA Representative.

2. Minimum - Use value in weaker principal direction. All numerical values represent minimum average roll value (i.e., test results from any sampled roll in a lot shall meet or exceed the minimum values in the table). Lot sampled according to ASTM D4354.
3. Permittivity & AOS indirectly relate to filtration performance of silt fence fabrics. Values presented reflect minimum criteria of products currently used.
4. Strength retained after 500 hours of ultraviolet exposure when tested according to ASTM D4355. This method specifies tensile testing by 2-inch strip (or ravelled strip) for both control and exposed samples.

B. Silt Fence Posts

Posts shall be either steel or wood having a minimum length of 18 inches plus burial depth. Posts shall be of sufficient strength to resist damage during installation and to support applied loads.

2.2 CONSTRUCTION ENTRANCES

A. Coarse Aggregate

Coarse aggregate used for the construction entrances shall be clean hard durable stone matching AASHTO No. 1 size/gradation requirements. The stone shall be of such quality that it will not disintegrate on exposure to water or weathering. The source of the aggregate shall be from a quarry operation permitted by Indiana Department of Environmental Management and acceptable for general construction use.

B. Filter Fabric

Construction entrances shall be underlain by a non-woven geotextile filter fabric material possessing a minimum grab strength of 200 lbs/in and minimum puncture strength of 90 lbs.

2.3 TEMPORARY SEED

If construction schedule prevents final seeding as described in Section 02936 or temporary seeding is deemed necessary for any other reason, such temporary seeding shall be performed using annual ryegrass (Lolium multiflorum). Seed shall be packaged for use during the year of construction activity.

PART 3: EXECUTION

3.1 FAMILIARIZATION

Prior to implementing any erosion and sediment control measures, the Contractor shall become thoroughly familiar with the Site, the Site conditions, applicable local, state and federal standards for soil erosion and sediment control, and all portions of the work pertaining to and/or related to this section.

3.2 SILT FENCE INSTALLATION

A. A trench six (6) inches wide and six (6) inches deep shall be excavated with equipment such as a trenching machine or motor grader; or, if equipment cannot be operated at that location, by hand.

B. Post installation shall start at the center or the low point (if applicable) with the remaining posts spaced a maximum of six (6) feet apart. Posts shall be installed with at least a minimum of eighteen (18) inches in the ground. When stake depths are less than eighteen (18) inches, but greater than twelve (12) inches, the post spacing shall be reduced to four (4) feet apart. When the posts can not be driven twelve (12) inches, the Contractor shall pre-drill the post location to facilitate installation to the target (12 to 18 inch depth).

C. Geotextile shall be securely attached to the post by wire, cord, staples, or other acceptable means as approved by the QA Representative. The Contractor shall overlap adjacent geotextile sections as shown on Sheet 12.

D. The trench shall be backfilled so that no stormwater and/or sediments can pass under the barrier. Backfill material shall be properly compacted to provide a stable anchor for the geotextile.

E. At the time of installation, geotextile shall be rejected if it has defects, rips, holes, flaws, deterioration, or damage incurred during manufacture, transportation, storage, or installation or at anytime is deemed so by the QA Representative.

3.3 CONSTRUCTION ENTRANCES

A. Construction entrances, if required by the Contractor's sequence of construction shall be installed following soil remediation at locations to be proposed by the Contractor to support his proposed approach and sequence of work. The subgrade shall be prepared by grading to smooth irregularities and remove vegetation or stumps (not addressed by clearing or soil removal).

B. The geotextile filter fabric shall be placed immediately after subgrade preparation with each section of fabric having a minimum overlap of 1 ft.

C. Placement of the coarse aggregate shall immediately follow installation of the geotextile in a method to prevent damage to fabric. Entrances shall be sized to accommodate the Contractor's construction equipment, but shall have a minimum size equivalent to the CRZ (Sheet 12). The coarse aggregate shall have a minimum thickness of 12 inches.

3.4 TEMPORARY VEGETATIVE COVER

A. Any completed restoration areas not protected by stone shall receive a temporary vegetative cover if they will not be permanently seeded within twenty (20) calendar days from completion of final grading.

B. Annual ryegrass shall be applied by broadcast seeding at a rate of 40 pounds per acre to establish the temporary vegetative cover.

3.5 MAINTENANCE AND REMOVAL

A. The Contractor shall maintain the integrity of silt fence, construction entrance and other erosion and sedimentation control measures as long as they are necessary to contain sediment associated with Work.

B. The Contractor shall inspect all temporary facilities at least daily and report the results of the inspection in the daily quality control report. Any deficiencies shall be immediately corrected by the Contractor.

C. In addition, the Contractor and the QA Representative shall make a daily review of the location of silt fences in areas where construction activities have changed the natural contour and drainage runoff to ensure that the silt fences are properly located for effectiveness. Where deficiencies exist, additional silt fences shall be installed as requested by the QA Representative. Should the silt fence become damaged or otherwise ineffective while the barrier is still necessary, it shall be repaired promptly. Sediment deposits shall be removed when the deposit reaches approximately one-half of the height of the silt fence and placed in the containment cell.

D. The temporary erosion control measures shall remain in place until the QA Representative requests that they be removed. Upon removal, the Contractor shall remove and dispose of any stone and excess silt accumulations, dress the area to give a positive aesthetic appearance, and restore all bare areas with a vegetative cover in accordance with Section 02936. Materials protecting exclusion zone areas, including silt fence materials, which are removed, shall be disposed of in the containment cell.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Silt fence shall be measured in lineal feet installed. Sediment removal shall not be measured. Measurement of temporary seed is addressed in Specification 02936. Construction entrances shall be measured as units. Dust suppression will be considered incidental to other project activities and will not be measured. See Specification Section 02999 for additional information regarding dust control. The proposed access ramp into the Containment Cell will not be measured.

4.2 PAYMENT

Silt fence shall be paid for per lineal foot which shall include full compensation for the specified work. This payment shall be full compensation for furnishing all materials and erecting, maintaining and removing silt fence.

Payment for construction entrances shall be per unit installed and shall include all stone, geotextile and other materials, labor and equipment required for installation. Payment for construction entrances and temporary access road shall be made in two payments, one after installation and the second after removal of the feature and restoration of the area. The proposed access ramp into the Containment Cell is considered incidental to the cost for excavation handling and placement of remediated soil and will, therefore, not be paid separately.

The completed work shall be paid in accordance with the following unit price schedule.

PAY ITEM	PAY UNIT
Unreinforced Silt Fence	Lineal Foot
Construction Entrance	Each

END OF SECTION

SECTION 02150

DEMOLITION OF REMNANT STRUCTURES

PART 1: GENERAL

1.1 DESCRIPTION

The work covered by this section shall include the demolition of remnant structures and pavement and the segregation, cleaning, sizing and on-site reuse of concrete and masonry rubble, and on-site disposal or off-site recycling of all other debris generated during the demolition process. The Contractor shall be responsible for furnishing all expertise, supervision, equipment, labor, material and all other services required to complete the work specified herein.

1.2 RELATED SECTIONS

A. Section 01010 - Summary of Work

B. Section 01050 - Field Engineering

C. Section 01351 - Health and Safety Plan Requirements

D. Section 01355 – Waste Management and Disposal Plan Requirements

E. Section 02100 – Site Preparation

F. Section 02115 - Erosion and Sediment Control Measures

G. Section 02209 – Excavation/Handling/Placement

H. Section 02715 - Water Management During Construction

I. Section 02936 – Site Restoration

J. Section 02999 – Dust Control and Air Monitoring

1.3 REFERENCES

40 CFR 263 - Standards Applicable to Transporters of Hazardous Waste
40 CFR 268 - LDRs - Standards for Decontamination and Disposal of Debris Contaminated by Hazardous Wastes

1.4 SUBMITTALS

Contractor shall submit bills of lading, manifests, weight tickets and certificates of disposal or recycling to the QA Representative for all materials shipped from the site.

Contractor shall submit results of all debris sample analyses (if required) at least 24 hours prior to off-site disposal, if used.

1.5 QUALITY ASSURANCE

Contractor shall ensure that demolition activities are performed in accordance with the Construction Quality Assurance Plan (CQAP). The QA Representative shall observe all sampling activities conducted by the Contractor.

PART 2: PRODUCTS

2.1 DEMOLITION EQUIPMENT

Equipment used by the Contractor for demolition activities shall be intended for such activities by the manufacturer and shall be approved by the Owner and QA Representative.

2.2 DUST SUPPRESSION MATERIALS

Dust suppression materials shall be non-toxic and biodegradable and shall be approved by RMC and QA Representative.

PART 3: EXECUTION

3.1 GENERAL

All work shall be performed in an organized, controlled, and safe manner. Such work shall not interfere with other construction operations. Blasting shall not be permitted for any demolition task. Burning of demolition debris shall not be permitted. It is the responsibility of the Contractor to conduct work in accordance with all local, state and federal regulations and to obtain all required permits prior to the start of demolition or demolition related activities.

Metal debris identified on-site shall be recycled off-site to the extent practicable. Concrete rubble and masonry shall be segregated, crushed, sampled and analyzed as specified in Section 02210. All other debris shall be transported to the Containment Cell, unless indicated by the QA Representative that off-site disposal is required. The maximum size of debris to be placed in the containment cell shall not exceed 12-inches in the longest dimension unless specifically approved by the QA Representative.

3.2 STRUCTURES TO BE DEMOLISHED

The following structures or portions thereof, decontaminated on all exposed surfaces during the 2009 facility decontamination and demolition project (except the lagoon), shall be demolished as part of the Work:

- Lagoon;
- Pump Houses 1 through 4 (including sumps);
- Former Refining Area Pit;
- Former Material Storage Building Loading Dock;
- Remnant Equipment Pedestals;
- Perimeter Wall;
- Concrete and asphalt paving;
- Concrete walls;
- Building foundations and footings;
- Miscellaneous abandoned utilities;
- Fencing; and,
- Non-active utility poles.

Concrete and masonry rubble materials (except those specifically prohibited in Section 02210) shall be reduced to 4" - minus and stockpiled in 500 cy piles in a designated area for characterization sampling for possible reuse during site restoration. If characterization sampling demonstrates that the material meets the requirements established in Section 02210, the material shall be utilized for site restoration. If the material fails to meet the requirements established in Section 02210, the material will be placed in the containment cell.

The Contractor shall ensure that the demolition activities do not damage or impact any surrounding completed work. The Contractor shall implement dust suppression methods during demolition to prevent the migration of fugitive dust particles from the Site. Dust control and air monitoring shall be conducted as required by Section 02999.

3.3 PREPARATION

Prior to any demolition activity, the Contractor shall perform the following activities:

A. Install all erosion and sediment control measures in accordance with Specification 02115;

B. The Contractor shall remove and stockpile concrete and masonry rubble. All rubble shall be reduced in size using standard construction procedures to 4" minus where applicable and stockpiled for characterization. Trash and debris shall be placed in the Containment Cell.

C. The Contractor shall verify that all utility connections to the former buildings have been disconnected and abandoned per Specification 02100;

D. The Contractor shall install all necessary high-visibility fencing, ribbons, or other work area markings such that unauthorized personnel do not enter the work area.

3.4 DUST CONTROL

The Contractor shall provide all expertise, supervision, labor, materials and equipment necessary to prevent the release of fugitive dust emissions that result from demolition activities. Visible airborne dust shall not be permitted. Contractor may use water, foam or other no-toxic and biodegradable dust suppression agents as approved by the QA Representative. The QA Representative shall judge the effectiveness of dust control measures.

3.5 DEBRIS DISPOSAL

Metal debris shall be segregated from non-metal debris. Each shall be disposed of in accordance with the following requirements:

A. Metal debris that can be readily cleaned to a clean surface in accordance with 40 CFR 268.45 shall be cleaned, sorted, sized for transportation and sort for scrap, if feasible. Copies of weight tickets and certificates of recycling shall be submitted to the QA Representative for project documentation. Off-site recycling facilities shall be approved by the RMC.

B. Non-metal debris that cannot be recycled shall be placed in the Containment Cell.

Materials proposed for off-site disposal (if any) shall be approved by the QA Representative prior to shipment. Unapproved loads shall not be sent off-site. Copies of all bills-of-lading shall be provided to the QA Representative immediately after shipment and weight tickets and certificates of disposal or recycling within two weeks of shipment. RMC must sign all manifests.

3.6 CONCRETE AND ASPHALT REMOVAL

Asphalt located within excavation areas shall be removed, sized to 12"-minus and placed within the Containment Cell. Concrete removal shall be performed to minimize cross-contamination with underlying soils, separated for sizing and characterization sampling pursuant to Section 02210.

3.7 SAMPLING AND ANALYSIS

The Contractor is responsible for collection and analysis of all materials proposed for off-site disposal.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Demolition activities will not be measured.

4.2 PAYMENT

Demolition of the pump houses will be paid for on a structure by structure basis. Concrete and asphalt pavement, foundations and miscellaneous pedestals will each be paid for on a lump sum basis. Demolition of the former loading dock will be paid for on a lump sum basis. Concrete and asphalt demolition costs shall include sorting, sizing (i.e. crushing) and segregating. Miscellaneous rubble and concrete not approved for use as fill shall be placed in the containment cell at no additional charge.

PAY ITEM	PAY UNIT
Pumphouses	Each
Loading Dock	Lump Sum
Concrete and Asphalt Pavement	Lump Sum

These bid items shall include all necessary work including but not limited to demolition, segregation of materials, recycling, sampling, analysis and handling. Demolition of miscellaneous utilities and utility poles will be considered incidental to excavation activities and will not be tracked or paid for separately.

END OF SECTION

SECTION 02209

EXCAVATION/HANDLING/PLACEMENT

PART 1: GENERAL

1.1 DESCRIPTION

A. The Work covered by this section includes, but is not limited to, the furnishing of all labor, supervision, equipment, materials and supplies necessary to perform excavation, handling and placement of contaminated soils, sediment and miscellaneous debris and rubble removed during the course of the work.

B. The specific areas of soil and sediment proposed for removal are designated on Sheets 6, 7 and 8 of the design drawings. Information related to the stakeout of proposed excavation areas are provided in Section 02100.

1.2 RELATED SECTIONS

A. Section 01050 – Field Engineering

B. Section 01351 - Health and Safety Plan Requirements

C. Section 02100 - Site Preparation

D. Section 02110 - Site Clearing and Grubbing

E. Section 02115 - Erosion and Sediment Control Measures

F. Section 02150 – Demolition of Remnant Structures

G. Section 02715 – Water Management During Construction

H. Section 02936 – Site Restoration

I. Section 02999 – Dust Control and Air Monitoring

1.3 SUBMITTALS

A. The Contractor shall provide two weeks prior to the start of intrusive field activities a narrative description of the proposed sequence of construction listing the order of excavation areas. The sequence described in the narrative shall correspond to the construction schedule submitted under Section 01300 and include information regarding the means and methods by which the Contractor will perform removal from the proposed remediation areas (excavation), movement/transport from the excavation area to the Containment Cell (handling) and spread and compact the excavated materials within the Containment Cell (placement).

1.4 QUALITY ASSURANCE

A. RMC will provide a full-time Quality Assurance (QA) Representative during corrective measures. The QA Representative will be responsible for implementing the QA procedures detailed in the Construction Quality Assurance Plan (Attachment D). The Contractor will be responsible accommodating the QA Representative during the collection of field measurements and confirmation of information.

PART 2: PRODUCTS

2.1 GENERAL

A. The Contractor's bid shall identify products and equipment proposed for excavation, handling and placement. Such items must be appropriate for accomplishing the proposed work in accordance with generally accepted industry standards for similar work.

PART 3: EXECUTION

3.1 GENERAL

A. The vertical and horizontal limits of proposed soil and sediment excavation represent initial required removal depths based on sampling activities completed during the Closure Investigation and RCRA Facility Investigation. The Contractor shall implement appropriate controls to ensure attainment of the target removal limits. Copies of the design drawings in AutoCAD will be provided to the Contractor for use in obtaining coordinates necessary for stakeout and establishment of grids.

B. The Contractor shall take appropriate measures to control at all times dust and dirt, both wind blown and from machine operation. The Contractor shall monitor air quality in and around the work area. Dust control and air monitoring requirements are provided in greater detail in Section 02999 of these Specifications.

C. Prior to intrusive activities, the Contractor shall evaluate proposed excavation and removal areas with the QA Representative for protection and delineation pursuant to the relevant sections of the Specifications, including but not limited to Section 02100 - Site Preparation; Section 02115 - Erosion and Sediment Control Measures; and Section 02715 – Water Management During Construction.

D. As described in greater detail below, initial excavation activities will be limited to soil removal within the footprint of the proposed Containment Cell. Full-scale excavation activities may not proceed until completion of the base berms and construction entrance of the Containment Cell unless specifically approved by the Engineer in writing following a demonstration by the Contractor that a partially completed configuration will provide adequate capacity and containment.

3.2 CONTAINMENT CELL PREPARATION

A. As depicted on Sheets 5 and 7, soil remediation is required within a portion of the Containment Cell footprint before construction of the containment cell can be performed. In addition, up to 4 feet of cutting is required to achieve the cell design bottom.

B. The soil removal limits for excavation area NW, as depicted on Sheet 7, shall be staked out pursuant to the Specifications. The target removal depth in excavation area NW is 12-inches below the existing ground surface. Soil excavation will be performed across the western portion of the NW excavation area.

C. After attainment of the target removal limits, confirmatory sampling will be performed following the post-excavation sampling techniques described in the Construction Quality Assurance Plan (CQAP).

D. Excavated soil from area NW shall be placed in a temporary stockpile on the eastern portion of excavation area NW or an alternate location approved by the Engineer. The stockpile shall be covered with plastic sheeting and be protected by straw bales or silt fence around the base.

3.3 EXCAVATION

A. The Contractor will be responsible for determining the specific sequence of the proposed removal activities, but unless approved otherwise by the Engineer, the general sequence shall begin at the highest elevations on-site and progress outward. This concept envisions work progressing as follows:

i. Excavation and removal of lagoon contents, liner system and adjacent soil excavation areas inside of fence;
ii. Soil excavation within HWMU excavations areas (Sheet 6), Corrective Measures excavation area FL-4B and balance of NW;
iii. Soil excavation within Corrective Measures excavation areas along western portions of site (FL-1 through FL-5, starting at FL-5 and working north);
iv. Soil/sediment excavation along South Arlington Avenue north of main entrance;
v. Soil/sediment excavation along main driveway;
vi. Soil/sediment excavation along South Arlington Avenue south of main driveway;
vii. Soil/sediment excavation along railroad spur (both sides);
viii. Soil/sediment excavation along CSX right-of-way north of site and onto Citizens Gas property; and,
ix. Soil excavation between Citizens Gas property line fence and railroad tracks along Big Four Road.

B. Excavation equipment shall be appropriately sized for the nature of the work being performed and conditions in the work area. All equipment shall be in good working order and well maintained with no fuel, oil or other leaks.

C. To the extent possible, excavation shall be performed in a manner that avoids entry of excavation or transportation equipment into completed areas or areas not designated for remediation.

D. Temporary stockpiles may be utilized for staging remediated materials awaiting loading into trucks and transport to the containment cell but such piles may only be located within the limits of contiguous excavation areas where remediation has not been completed. If temporary stockpiles must be located on previously remediated areas or areas not designated for remediation, the Contractor shall protect the ground surface against cross-contamination using plastic sheeting beneath pile. After the pile is removed the plastic sheeting shall be removed and ground surface inspected by the QA representative. If the QA Representative suspects cross-contamination, the underlying soil shall be scraped to remove suspected cross-contamination.

E. Contractor shall monitor removal depths while work is progressing to avoid over or under excavation. Removal depths shall be measured from the starting ground surface, such that bottom of the excavation replicates the beginning ground surface.

F. Area of standing water shall be removed from proposed excavation areas pursuant to the requirements of Section 02715 or allowed to infiltrate prior to the start of excavation activities.

G. Excavation shall be sequenced to maintain uninterrupted access to the Containment Cell.

3.4 HANDLING

1. The Contractor shall load excavated soil, sediment and debris (remediated materials) directly into trucks for transport to containment cell.

2. The Contractor's trucks shall be in good working condition with locking tailgates to prevent the spillage of materials while in transit. The trucks shall be staged near the work area for loading and within the exclusion zone whenever possible. Trucks moving across the Site within the exclusion zone shall follow the designated exclusion zone access roads.

3. Trucks shall travel at speeds that do not create fugitive dust. If dust is observed coming from the trucks wheels that, in the opinion of the QA Representative, is or could potentially affect surrounding areas the Contractor will be required to cease transport activities until the truck route can be re-wet to prevent dusting. Whenever possible, trucks shall travel from the active excavation areas to the Containment Cell without leaving the exclusion zone.

4. When the truck is not staged for loading within the exclusion zone (such as during off-site excavation activities and excavation along the main driveway), the Contractor shall establish a temporary loading area, which includes the use of plastic sheeting placed beneath the truck. When a loaded transport vehicle prepares to leave the temporary loading area the truck must be inspected for loose materials on its sides, wheels and undercarriage or material piled above the top of the sides. When such materials are found, the Contractor shall remove the

materials to the satisfaction of the QA Representative. Trucks traveling outside the exclusion zones must be covered.

3.5 PLACEMENT

1. Excavated materials shall be delivered to the Containment Cell for placement and compaction. To the extent possible, dumping shall be performed in a manner that does not require tracking of the trucks across previously placed soil. The Contractor shall provide a designated piece of equipment, such as a small dozer for movement of excavated materials in the cell.

2. During placement, excavated materials shall be spread in uniform lifts with a maximum loose lift thickness of 18-inches. Each lift shall be compacted until visually stable as determined by the QA Representative. Rubble material placed in the cell shall not be greater than 12 inches thick and shall be placed to prevent voids. Liner materials removed from the lagoon or temporary covers placed over the former MSB and Battery Breaker floors shall be placed flat to prevent bunches and not less than 20 feet from the design exterior slopes. The liner material disposed in the cell shall be intentionally sliced to prevent the accumulation of precipitation on the liner material.

3. At the end of each work day, or when work is stopped because of precipitation, the fill surface shall be smooth rolled to prevent infiltration and promote runoff. The fill surface shall be sloped to direct runoff towards a low point where the contractor can collect and manage storm water pursuant to Specification section 02715.

4. When filling progresses above elevation 843, the Contractor shall perform filling to create a drainage diversion around the perimeter of the cell to protect against over-topping.

5. The Contractor shall maintain the fill surface in a condition that is sufficiently moist to prevent the generation of dust during filling operations or during wind.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Measurement of removal, handling, and placement of soils, sediment, and waste in the Containment Cell shall be based on cubic yards excavated as determined by pre- and post-excavation surveys. Contractor's surveyor shall calculate removal volumes using average end area method (soils) or similar method approved by the QA Representative. Wastes and debris generated from decontamination and demolition activities will not be measured. Water management shall be considered incidental to the work.

4.2 PAYMENT

Removal, handling, and placement of soil, sediment and waste materials will be compensated using the unit price indicated on the bid sheet. Handling and placement or disposal of waste and debris from demolition activities will not be paid as a separate item, said costs shall be included in those bid items.

PAY ITEM	UNIT
Removal/Handling/Placement Soils and Sediment	Cubic Yard

END OF SECTION

SECTION 02210

EARTHWORK

PART 1: GENERAL

1.1 DESCRIPTION

The work covered by this section shall include, but not be limited to, the furnishing, excavating, hauling, handling, placement, and compaction of fill soil for excavation backfill, general site grading, and soil cover layer on the cap. Specific requirements associated with final surface restoration of the work areas, using coarse aggregate, seeding, or sod is provided in Section 02936 (Site Restoration).

1.2 RELATED SECTIONS

A. Section 01010 - Summary of Work

B. Section 01050 - Field Engineering

C. Section 01300 - Submittals

D. Section 01400 - Quality Assurance/Quality Control

E. Section 01351 - Health and Safety Plan Requirements

F. Section 02100 - Site Preparation

G. Section 02110 - Site Clearing and Grubbing

H. Section 02115 - Erosion and Sediment Control Measures

I. Section 02209 - Excavation/Handling/Placement

J. Section 02715 - Water Management During Construction

K. Section 02720 – Site Stormwater System

L. Section 02936 - Site Restoration

1.3 REFERENCES

ASTM D421 - Test Method for Dry Preparation of Soil Samples for Particle Size Analysis and Determination of Soil Contents

ASTM D422 - Test Method for Particle-Size Analysis of Soils

ASTM D1557 -	Test Method for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 10-lb (4.5-kg) Hammer and 18-inch (475-mm) Drop
ASTM D2922 -	Test Method for Density of Soil and Rock In-Place by Nuclear Methods (Shallow Depth)
ASTM D3017 -	Test Method for Moisture Content of Soil and Soil Aggregate In-Place by Nuclear Methods (Shallow Depth)

1.4 DEFINITIONS

Structural Soil Fill - Material utilized for construction of Containment Cell berms or perimeter access roads, backfill around stormwater management basin outlet structure and pipes, and backfilling excavations greater than 2 feet deep relative to proposed restoration grading.

General Site Fill - Material placed in conjunction with cutting from one area within the RMC property boundary and filled within another, after completion of required remediation.

Cap Soil Fill - Material to be placed as cover soil within the containment cell cap.

Granular Fill - Material used for backfill beneath the groundwater table and as on-site surface stone aggregate.

1.5 SUBMITTALS

Prior to the start of on-site activities, the Contractor shall submit to the QA Representative for review and approval, a copy of analytical laboratory testing for each soil fill material. The Contractor shall also submit for each imported fill material gradation, plasticity index (P.I.) and Modified Proctor test results for every 3,000 cubic yards of each type of soil fill material placed or when a change in the character of the material is noted by the QA Representative. In addition the Contractor shall provide internal shear strength and cohesion testing (as well as interface friction testing required by Section 02755) for the cap soil fill. **<u>During execution, the contractor shall provide field compaction test reports and bills of lading for all delivered materials with the Daily Field Reports</u>**.

1.6 QUALITY ASSURANCE

Quality assurance of earthwork operations shall be performed in accordance with the Construction Quality Assurance Plan (CQAP). As described in the CQAP, earthwork will be monitored and tested by the Contractor's QC personnel, with review and oversight by the RMC's QC Representative.

PART 2: PRODUCTS

2.1 STRUCTURAL SOIL FILL

Structural soil fill shall be used to fill excavations up to the proposed subgrade for proposed surface restoration, construction of the containment cell berm, and construction of the storm water management basin berms. The material shall be capable of supporting construction loads to assure stability. The structural soil fill shall also be free of organic matter, debris, roots, vegetation, or other deleterious material. Imported structural soil fill shall be classified as non-plastic, as defined by ASTM D 2487 Soil Classifiaction Group (such as SW, SM or SC). Maximum particle size for imported structural soil fill shall be 3-inches. Imported soil fill shall be analyzed for TAL Metals (Method 6010/6020)/TCL VOCs and SVOC (Methods 8260 and 8270) compounds and shall be less than IDEM RISC Default Residential Standards for Direct Contact and Soil to Groundwater, whichever is more stringent.

Materials generated from within the RMC property boundary (including crushed/recycled concrete) may be utilized as unrestricted structural soil fill if they are approved by the QA Representative as geotechnically acceptable and are tested once every 500 cubic yards for antimony, arsenic, cadmium, lead and selenium and proven to have concentrations below the standards established for HWMU closure. If such materials are geotechnically acceptable to the QA Representative, but have lead concentrations >400 mg/kg and <920 mg/kg, while meeting the HWMU closure requirements for the other parameters they may be utilized as structural soil fill outside the footprints of the HWMU.

2.2 GENERAL SITE FILL

Following completion of proposed remediation and receipt of acceptable confirmatory sampling results, the Contractor may cut into areas protruding above the proposed subgrade for final grading and utilize cut materials as fill in low areas <2 ft below proposed finished grades. General site fill may be utilized as structural soil fill when they meet the general geotechnical requirements for structural soil fill and are approved by the QA Representative. General site fill cut from within the limits of the HWMUs may be used anywhere within the RMC property, but general site fill cut from outside the footprints of the HWMUs may only be utilized outside the footprints of the HWMUs. Analytical testing of General Site Fill is not required because the areas from which such material is derived will have been proven to have met the site remediation standards through the required confirmatory sampling.

2.3 CAP SOIL FILL

Cap soil fill placed as part of the cap shall meet the specified requirements for structural fill above except that material shall fall within the USCS soil classification of CL, ML, SC, or SM, be free of rock fragments larger than 2 inches and have a minimum cohesion at optimum moisture of 300 psf. The finished geomembrane subbase must be hard, uniform and smooth, and be free of soil, gravel or other particles larger than 2 inch diameter or of angular shape. Cap soil fill at the time of placement shall be between -5% and +3% of the optimum moisture content before completion. The cap soil shall have a minimum angle of internal friction of 28 degrees and a minimum wet unit weight at 95% compaction of 120 pounds per cubic foot (pcf). Cap soil fill shall be analyzed for TAL Metals (Method 6010/6020)/TCL VOCs and SVOC compounds (Methods 8260 and 8270) and shall be less than IDEM RISC Default Residential Standards for Direct Contact and Soil to Groundwater, whichever is more stringent.

2.4 GRANULAR FILL

Granular Fill shall be hard, durable crushed stone or gravel with 100 percent passing the 4" sieve and no greater than 10 percent passing the #4 sieve. Granular fill shall be analyzed for TAL Metals (Method 6010/6020)/TCL VOCs and SVOC compounds (Methods 8260 and 8270) and shall be less than IDEM RISC Default Residential Standards for Direct Contact and Soil to Groundwater, whichever is more stringent unless the material is produced by an IDEM permitted quarry and is approved by IDOT for unrestricted use. The contractor may also utilize crushed/recycled concrete derived from on-site for use as granular fill with the approval of the geotechnical characteristics by the QA Representative and are tested once every 500 cubic yards for antimony, arsenic, cadmium, lead and selenium (Method 8260) and proven to have concentrations below the standards established for closure of the HWMUs.

PART 3: EXECUTION

3.1 GENERAL

All fill shall be placed to the lines and grades as shown on the Drawings. Survey controls required for earthwork placement shall be established by an Indiana licensed professional surveyor retained by the Contractor. Controls shall be established based on the vertical and horizontal reference systems established by the Contractor's Surveyor at the start of the project.

The Contractor is responsible for ensuring that all earthwork materials meet this Specification. Any material not in conformance will be rejected and removed from the Site at Contractor's expense.

3.2 FAMILIARIZATION

Prior to the start of earthwork activities, the Contractor shall become thoroughly familiar with the Site, the Site conditions, and all portions of the work falling within this section. The Contractor shall carefully inspect the completed work of other sections and verify that all work is complete to the point where the work covered by this section may commence. Any conflicts or concerns with work completed which may impact earthwork should be brought to the RMC's attention in writing.

3.3 SITE PREPARATION

The Contractor shall maintain the temporary erosion and sediment controls installed prior to excavation as described in Section 02115 of the Specifications.

3.4 FILL AREA PREPARATION

Material shall not be placed in any fill zone until the subgrade of that zone has been suitably prepared, and has been approved by the QA Representative. The foundation for the fill shall be prepared by leveling and rolling, where applicable, so that the surface materials of the foundation will be compact and well-bonded with the first layer of fill as herein specified for the subsequent layers of fill. Any areas which are noted to pump, deflect, or be unsuitably soft, as determined by the QA Representative, shall be excavated and replaced with suitable material or stabilized by other means, at the discretion of the QA Representative. Under no circumstance shall backfill be placed on peat, marsh deposits, topsoil or any other organic strata. Areas where fill is to be placed shall be clean, and free of standing water, vegetation or soft zones.

3.5 PLACEMENT OF FILL

Brush, roots, sod, organic matter and other unsuitable materials shall not be placed within any fill area (excluding Containment Cell contents). The Contractor shall remove and dispose of all unsuitable items within the fill encountered during dumping or spreading. All fill shall be placed in layers and compacted. Loose lift thickness shall not exceed 12 inches, except for the cap soil fill which shall be placed to achieve a single compacted lift thickness of 18-inches.

Excavations which extend into the groundwater table shall be backfilled with granular fill to the groundwater table to create a stable surface for placement of subsequent layers of structural soil fill.

If the compacted surface of a fine grained material is determined to be too smooth to bond properly with the succeeding layers, it shall be loosened by harrowing or by any other methods as approved by the QA Representative before the succeeding layer is placed.

Placement of fill materials shall be suspended when, in the opinion of the QA Representative, the climatic conditions are unsatisfactory for placing fill to conform to these Specifications.

The Contractor shall maintain and protect all fill areas in a satisfactory condition at all times until final completion and acceptance of the work. The Contractor shall excavate and remove, from the fill, any material which the QA Representative considers unsuitable and shall also dispose of such material and refill the excavated areas as directed.

The Contractor may be required to remove any fill material placed outside of the lines and grades shown in the Drawings at no expense to the RMC.

When constructing fill against an existing slope (such as embankment filling), the slope shall be properly benched according to standard construction practice. The QA Representative shall monitor benching to assure that the bench is at least 2 feet and not greater than 4 feet into the existing slope for every 2 feet thickness of material placed. Cap soil fill shall be placed using techniques and sequencing that will not damage the cap geosynthetic components or cause sliding.

During earthwork operations, all fill materials shall be monitored by the Contractors QC personel with oversight by the QA Representative to determine conformance to the project Specifications. Additional testing shall be performed whenever a significant material variation is observed or as required by the CQAP.

3.6 COMPACTION

The Contractor shall compact all soil fill and granular fill. All compaction equipment shall be suitable to the slope and area conditions of the Site, and shall be subject to approval by the QA Representative. If necessary, hand-operated compaction equipment such as mechanical tampers shall be used for working in confined areas. Compaction of fill shall produce a stable material that does not exhibit pumping or rutting as determined by the QA Representative based on visual observations. At the end of each day's construction activities, completed lifts or sections shall be sealed by rolling with a rubber tired or smooth-drummed roller or by backdragging with a bulldozer. Density testing shall be conducted by the Contractor's QC personnel using nuclear density gauge or similar approved methods every 1,000 sf of structural soil fill or cap soil fill placed per lift (approximately 1 test every 37 cy). A minimum of one test shall be conducted per lift, regardless of lift size. Additional testing will be performed if in the opinion of the QA Representative test results are marginal or stability of the compacted material based on visual observations is suspect. Materials shall be compacted until a density 92% of the Modified Proctor density is obtained. General site fill and granular fill shall be compacted until stable.

<u>The Contractor shall present nuclear density gauge test results in the daily QC report</u>. Subsequent lifts shall not be placed until compaction test results meet the minimum requirements and approval is received from the QA Representative. Areas of failing tests shall be re-compacted or the moisture content of the fill material adjusted until test results pass.

Granular fill placed below the water table shall be compacted using the backhoe bucket or similar method. Nuclear density gauge testing is not required for granular fill, but stability must be approved by the QA Representative based on visual observations.

3.7 WATER MANAGEMENT

The Contractor shall be responsible for managing all precipitation, surface water, and groundwater entering the work areas. Contractor shall provide, maintain, and operate pumps and other equipment as necessary pursuant to Section 02715 - Water Management During Construction.

3.8 PROTECTION OF FINISHED WORK

The Contractor shall implement appropriate measures to protect completed work areas and construction materials from damage by Site activities, vandalism, flooding or other forces whether natural or man made. If damage occurs to work areas the Contractor shall make all repairs and replacements necessary, as determined by the QA Representative, at no additional cost to the RMC.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Structural soil fill, granular fill, and general soil fill shall be measured by cubic yards of fill in place. In place volumes shall be determined by standard survey techniques. Any fill placed for the convenience of the Contractor shall not be measured. Cap fill shall be measured on a square yard basis.

4.2 PAYMENT

Payment for structural soil fill, granular fill, cap soil fill and general soil fill shall be in accordance with the unit price schedule. The prices shall include all equipment, labor, materials, and expertise required to perform the fill in accordance with the CMD, or as directed by the QA Representative.

Prices shall also include, but will not be limited to, borrow area selection, preconstruction testing, every 3,000 cy ongoing testing, subgrade preparation, placement, compaction, trimming, field quality control, surveys, and maintenance and protection of final grades.

All work associated with furnishing and hauling material will not be paid separately but shall be included in the unit price.

No additional payment will be made for removing approved fill material which is rendered unsuitable after placement or replacement; for removal, hauling, disposal and replacement of objectionable fill material; nor for any fill material placed outside of the lines and grades as shown on the design drawings or approved by the QA Representative.

Completed work shall be paid in accordance with the unit price schedule.

PAY ITEM	PAY UNIT
Structural Soil Fill	Cubic Yard
General Site Fill	Cubic Yard
Granular Fill	Cubic Yard
Cap Soil Fill	Square Yard

END OF SECTION

SECTION 02715

WATER MANAGEMENT DURING CONSTRUCTION

PART 1: GENERAL

1.1 DESCRIPTION

The work covered by this section shall include, but not be limited to, the management of any storm water, surface water, decontamination water, or groundwater that flows or seeps into active work areas or other staging and support areas and surface water flow within ditches. The work includes the maintenance of silt fence and diversions around excavations to control run-on, continuous diversion of water within ditches during times of active flow, and installation and maintenance of measures to prevent transport of soil, waste, or sediment to downstream areas. Also included are the collection, management, treatment and discharge of water (including groundwater dewatering) from within work areas.

The Contractor shall be responsible for handling all water and groundwater as required to complete the work in a neat and dry condition and as detailed in these Specifications. The Contractor shall provide all expertise, supervision, labor, materials, and equipment necessary to perform the work as specified herein. The Contractor is responsible for preventing cross-contamination of areas of the Site not proposed for removal or already remediated.

1.2 RELATED SECTIONS

A. Section 01010 - Summary of Work

B. Section 01050 - Field Engineering

C. Section 01300 - Submittals

D. Section 01400 - Quality Assurance/Quality Control

D. Section 01351 - Health and Safety Plan Requirements

F. Section 02100 – Site Preparation

G. Section 02110 – Site Clearing and Grubbing

H. Section 02115 - Erosion and Sediment Control Measures

I. Section 02209 - Excavation/Handling/Placement

J. Section 02210 – Earthwork

K. Section 02720 - Site Stormwater System

L. Section 02936 – Site Restoration

1.3 SUBMITTALS

The Contractor shall submit a general description of the procedures for diversion and management of flow in ditches, storm water, decontamination water, and groundwater as part of the narrative description for construction sequencing included as part of the construction schedule. The Contractor shall also submit detailed information regarding the proposed treatment system, including treatment equipment, size and number of tanks, chemicals, pre- and post-treatment analytical methods and contingencies for handling treated water that fails discharge criteria after treatment.

1.4 QUALITY ASSURANCE

Quality assurance for water management operations shall be performed in accordance with the Construction Quality Assurance Plan (CQAP). As described in the CQAP for water management, the operations will be monitored by the QA Representative to ensure that work areas are free of surface water to the extent practical. The QA Representative shall periodically monitor the water management systems to ensure that they are adequately maintained.

PART 2: PRODUCTS

Any products used by the Contractor to temporarily divert, manage, or handle storm water, surface water, decontamination water, and groundwater shall be approved by the QA Representative and shall meet the requirements of the CM Design. Pumps, hoses and tanks shall be of adequate size to accommodate the anticipated flows and volumes.

PART 3: EXECUTION

3.1 GENERAL

The Contractor shall manage all water, including surface water, groundwater, decontamination water, and water within ditches, for the duration of the project in accordance with all local, state, and federal regulations and any and all permits obtained by the RMC or Contractor. Any discrepancy regarding management of water shall be resolved by the QA Representative.

Management features shall not be removed until restoration is complete and the QA Representative has approved removal of the features. The Contractor is responsible for ensuring that all water management operations meet this Specification and any activities not in conformance will be stopped and any costs due to delays will be at the Contractor's expense.

3.2 STORMWATER MANAGEMENT

The Contractor shall be responsible for keeping areas where construction activities are being performed dry to the extent necessary required for completion of the work and for removing storm water from the active work areas, if water does not infiltrate. The Contractor shall divert runoff water from entering active remediation areas using temporary erosion controls as necessary. Any storm water that does not infiltrate within work areas shall be pumped from the area and managed in accordance with Section 3.7.

3.3 GROUNDWATER

The Contractor shall anticipate groundwater flow into the deeper excavations (variable, but generally below elevation 839+/-). Any groundwater removed from excavations shall be managed in accordance with Section 3.7.

3.4 DECONTAMINATION WATER

Water generated during decontamination of personnel and equipment that does not infiltrate into un-remediated areas shall be collected and managed in accordance with Section 3.7.

3.5 DITCHES

Water within ditches shall be managed by the Contractor during remediation and restoration. Removal and construction in dry conditions is preferred. The Contractor will be required to prevent the transport of contaminated sediments downstream of the work area, prevent cross-contamination of clean areas, minimize the amount of water within the work area using sand bag diversions or other QA Representative approved techniques to temporarily control flow. Liquids removed from the work area shall be managed in accordance with Section 3.7.

3.6 SEDIMENT AND REMEDIATED SOIL DEWATERING

Liquids drained from sediments and other wastes shall be collected and managed in accordance with Section 3.7.

3.7 MANAGEMENT OF WATER

Surface water, storm water, decontamination water, and groundwater shall be collected, treated and discharged at the designated location (either sanitary sewer or drainage ditch). The Contractor is responsible for providing all collection areas, sumps, pumps, hoses, tanks, containers and other equipment necessary to collect and manage water. The Contractor shall provide tankage for storage of water prior to and after treatment.

The Contractor shall treat all collected water until the requirements of the permit are met.

3.8 TREATMENT SYSTEM

The Contractor shall submit details for the proposed treatment system with their bid. The treatment system, at a minimum, shall include filtration and other means of removing the target metals such as pH adjustment, additives for coagulation and/or flocculation, ion exchange and settling. The treatment system shall be temporary and include a means for management of sludges. Sludges shall be placed in the Containment Cell. Sludges generated after capping shall be disposed off-site at a facility approved by RMC. The treatment system shall include a flow meter with totalizer to record total volume. Records shall be provided in the Contractor's daily QC report. The Contractor shall submit a description of all proposed equipment, the minimum and maximum design flow rate, the source, and Material Safety Data Sheets for all additives.

Treatment shall be conducted in a batch process. After treatment, water shall be stored in a tank until post-treatment results have been reviewed by the QA Representative and the water has been approved for discharge. Post-treatment samples shall be analyzed for pH, lead, arsenic, zinc and TPH at a frequency of once per 30,000 gallons, or once per batch, whichever is more frequent. Treated water shall be approved by the QA Representative for discharge to the POTW.

The Contractor's QC personnel shall record the volume and flow rate of each batch, the dates of treatment, sampling and discharge, and the associated post-treatment analytical data in the daily QC report. Batches which do not meet the surface water standards shall be retreated and resampled.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Handling and management of surface water, storm water, decontamination water, and groundwater in and around the work areas is considered incidental and shall not be measured or paid for as a separate item. Handling of water within ditches shall be considered incidental to sediment removal activities.

Treatment of water shall not be measured.

4.2 PAYMENT

The treatment of water, including re-treatment if necessary, shall be paid for on a lump sump basis on a percent completion basis as determined by the QA Representative.

PAY ITEM	PAY UNIT
Water treatment	Lump sum

END OF SECTION

SECTION 02720

SITE STORMWATER SYSTEM

PART 1: GENERAL

1.1 DESCRIPTION

This section covers work associated with the installation of the proposed storm water management basin outlet structures, culverts, flared end sections and outlet protection/rip rap aprons.

1.2 RELATED WORK

A. Section 01050 - Field Engineering

B. Section 01300 - Submittals

C. Section 01351 - Health and Safety Plan Requirements

D. Section 01400 – Quality Assurance/Quality Control

E. Section 02100 - Site Preparation

F. Section 02115 - Erosion and Sediment Control Measures

G. Section 02209 - Excavation/Handling/Placement

H. Section 02210 – Earthwork

I. Section 02936 – Site Restoration

1.3 DEFINITIONS

ASTM - American Society for Testing and Materials

CQAP - Construction Quality Assurance Plan

OSHA - Occupational Safety and Health Administration

1.4 QUALITY ASSURANCE

Quality Control activities for installation of the site storm water features shall be performed by the Contractor in accordance with the pipe manufacturer's installation requirements and relevant section of these specifications. Products used for construction of storm water systems, including piping materials, pre-cast-concrete structures, bedding materials and backfill shall comply with specific parameters contained in these Specifications. The QA representative will review the manufacturer's installation procedures and review Contractor's installation procedures for consistency therewith.

1.5 REFERENCES

ASTM A48 - Specification for Gray Iron Castings

ASTM D421 - Test Method for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants

ASTM D2487 - Procedure for Classification of Soils for Engineering Properties

1.6 SUBMITTALS

Contractor shall submit pipe manufacturers recommended installation procedures to QA Representative for review and approval.

1.7 PRODUCT HANDLING

All products required for construction of the proposed culvert and storm water management basin outlet structure shall be handled in accordance with manufacturers' recommendations.

PART 2: PRODUCTS

2.1 STRUCTURAL SOIL FILL

Structural soil fill shall be used for backfilling over and around pipes and structures associated with the site storm sewer system. Structural soil fill shall meet the requirements of the earthwork section of these specifications (Section 02210).

2.2 BEDDING

AASHTO #57 crushed stone shall be used for the Corrugated Polyethylene (CPE) pipe bedding, base support for inlet box and backfill where required.

2.3 PIPE

A. The Corrugated Polyethylene (CPE) pipe shall be ADS –12, fifteen (15)-inch diameter pipe or engineer approved alternate with bell and spigot joints, soil tight fittings.

B. Flared end sections shall be manufactured or approved for use with the CPE pipe and utilize compatible fittings.

2.4 INLET STRUCTURE AND TOP UNIT

A. Inlet structure utilized for the storm water management basin outlet structure shall be a precast concrete 2' x 4' inlet structure for use with designed piping (size and material specified in design) with matching concrete frame (without curb) constructed using minimum Class AA precast concrete. Inlet structure shall be placed on eight (8) -inches of AASHTO #57. Inlet structure shall have a medium duty cast gray iron grate compatible with proposed frame.

2.5 RIP-RAP

Stone utilized as rip-rap shall match the requirements for material size and type as required for Drainage Ditch Aggregate as described in Specification Section 02936.

PART 3: EXECUTION

3.1 PREPARATIONS

A. The Contractor shall have completed clearing and grubbing and rough grading for the containment cell berm, drainage ditch and perimeter access road.

B. Temporary storm water management measures shall be installed and fully operational for the purpose of collecting and managing storm water runoff from active work zones and disturbed site areas.

C. Railroad rail and ties shall be removed from the location where proposed storm water pipe will cross railroad spur.

3.2 INSTALLATION

A. Excavation and Bedding

1. The Contractor shall ensure that the trenches are excavated to the lines and grades as shown on the Drawings.

2. The trench shall be excavated in such a manner as to be safe for personnel to enter the trench for installation of the piping. OSHA and all other applicable regulations including the Health and Safety Plan shall apply to this and all site activities.

3. Material excavated from the trench and structure sub-base and not used as backfill shall be segregated for use as structural soil fill with approval from the QA Representative.

4. Construct 6-inch thick layer of bedding by placing the AASHTO #57 material in a single lift over the approved stable subgrade. If subgrade is unstable, section shall be over excavated to a stable bottom and backfilled with AASHTO #57. Compact with a mechanical tamper. Form a cradle in the bedding material for piping by means of a template conforming to the curvature of the outside surface of the bottom of the pipe to provide uniform contact under and around the pipe. A minimum of eight (8)-inches of bedding shall be placed beneath proposed structures.

B. Pipe Placement

1. The Contractor shall excavate and construct proposed pipe as detailed on the design drawings. Pipe installation shall be in accordance with manufacturer's recommendations. Lay pipe in the cradle formed as specified above with bells up grade. Begin and end pipe at flared end sections or inlet structures as shown on drawings.

2. Control the pipe alignment and grade with suitable string lines, with an electronic laser beam system, or by other acceptable methods. Laser must be utilized for slopes less than two (2) percent.

3. Provide one (1)-foot minimum cover over the top of pipe for the storm sewer pipe.

4. Backfilling may proceed immediately after placement maintaining pipe in proper alignment and grade.

5. When pipes are connected with pre-cast concrete structures, cut off exposed pipe ends flush with the structure face and finish the inside and outside voids between the pipe and the precast opening with mortar.

C. Backfilling

Backfill shall be placed in lifts and compacted by the Contractor according to the requirement of Section 02210.

3.3 OUTLET PROTECTION

A rip rap apron (4 feet wide x 4 feet long x 9 inches thick shall be constructed at both the up-slope and down-slope flared end sections. The subbase for the rip-rap apron shall be lined with geotextile fabric.

END OF SECTION

SECTION 02751

CAP DRAINAGE LAYER

PART 1: GENERAL

1.1 DESCRIPTION

The Work covered by this section includes installation of the cap drainage layer for the containment cell cap systems. This includes manufacture, fabrication, packaging, delivery, and installation of all components. Specific components include the composite drainage layer (geonet/geotextile composite), perforated anchor trench drain, granular fill, and geotextile.

1.2 RELATED SECTIONS

A. Section 01050 - Field Engineering

B. Section 01300 - Submittals

C. Section 02210 - Earthwork

D. Section 02755 - Cap Barrier Layer

1.3 REFERENCES

ASTM D413 -	Test Method for Rubber Property-Adhesion to Flexible Substrate
ASTM D422 -	Test Method for Particle-size Analysis of Soils
ASTM D1682 -	Test Method for Strip Tensile Strength
ASTM D2487 -	Procedure for Classification of Soils for Engineering Purposes
ASTM D3776 -	Test Method for Mass per Unit Area (Weight) of Fabric
ASTM D4354 -	Standard Practice for Sampling of Geosynthetics for Testing
ASTM D4533 -	Test Method for Trapezoid Tearing Strength of Geotextiles
ASTM D4595 -	Test Method for Tensile Properties of Geotextiles by the Wide Width Strip Method
ASTM D4632 -	Test Method for Breaking Load and Elongation of Geotextiles (Grab Method)
ASTM D4716 -	Test Method for Constant and Hydraulic Transmissivity of Geotextiles and Geotextile Related Products
ASTM D4751 -	Test Method for Determining Apparent Opening Size of a Geotextile

ASTM D4759 -	Standard Practice for Determining the Specification Conformance of Geosynthetics
ASTM D4833 -	Test Method for Index Puncture of Geotextiles, Geomembranes and Related Products
ASTM D5321 -	Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method

1.4 SUBMITTALS

A. The Contractor shall submit Manufacturer's literature and specification for perforated piping to the QA Representative for approval. A minimum of four weeks prior to cap installation, the Contractor shall submit Manufacturer's specifications and physical property information for the composite drainage layer to the QA Representative for approval.

B. The Contractor shall have a geosynthetics testing laboratory perform shear box testing pursuant to ASTM D5321, for the soil/composite interface, composite/geomembrane interface, geomembrane/geotextile interface and geotextile/soil interface and shall include the results with the submittal for approval by QA Representative prior to delivery of materials to the site. Shear box testing shall be run at 3 psi, 1.5 psi, and 0.5 psi using site specific materials.

1.5 STORAGE

The composite drainage layer rolls delivered to the project site shall be stored in their original, unopened wrapping in a dry area and protected from precipitation and the direct heat of the sun. The materials shall be stored above the ground surface and beneath a roof or other protective covering.

1.6 QUALITY ASSURANCE

Quality assurance of geosynthetic installation shall be performed in accordance with the Construction Quality Assurance Procedure.

PART 2: PRODUCTS

2.1 GEONET

A. The geonet shall be a high density polyethylene (HDPE) material with intersecting material strands creating a three dimensional structure which supports planner water flow.

B. The geonet shall conform to the following requirements or the manufacturers minimum published values, whichever is more restrictive:

Properties	Test Method	Required Value
Transmissivity (M^2/S), min.	ASTM D4716 i = 1.0 Φ = 2000 psf	1.4×10^{-3}
Tensile Strength (lb/in), min.	ASTM D1682 or D4595	22

C. Contractor shall provide conformance testing as required by Construction Quality Assurance Plan.

2.2 PIPE

The pipe used within the perimeter cap drainage system (where required) shall be a four (4)-inch perforated corrugated polyethylene tubing (Class 2 Perforations) meeting the requirements of AASHTO M25-94. The pipe shall include all appropriate connections and end protection recommended by the manufacturer and as shown on the design drawings.

2.3 GEOTEXTILE

A. The geotextile bonded to the geonet shall be a non-woven material conforming to the following requirements. Geotextile shall be heat bonded to the geonet and extend a minimum distance of 6-inches beyond the geonet at either end of the cross machine direction.

Properties	Test Method	Required Value
Grab Strength (lbs.), min.	ASTM D4632	150
Puncture Strength (lbs.), min.	ASTM D4833	75
Tear Strength (lbs.), min.	ASTM D4533	70
Mass per Unit Area (oz/sy), min.	ASTM D3776	8
Apparent Opening (US sieve No.)	ASTM D4751	70
Ply Adhesion (lbs/in)	ASTM D413	1.0

B. The geotextile wrap used for the cap edge drains shall meet the same minimum requirements but will not be bonded to the geonet.

2.4 PEA GRAVEL FILL

Pea gravel fill shall be used as drainage material around the piping system for the perimeter cap drain and the cap edge drain. Granular fill shall be clean, rounded material with particles not larger than 1-1/2-inch in diameter and no greater than 5 percent fines (pea gravel).

2.5 INTERFACE FRICTION

Shear box testing shall be performed at confining pressures of 0.5, 1.5 and 3.0 psi. Shear box test results shall demonstrate that the composite drainage layer and geomembrane have the following values:

Cover Soil/geotextile of composite	22° min.
Geotextile of composite/textured geomembrane	22° min.
Textured geomembrane/geotextile	22° min.
Geotextile/soil	22° min.

Lower interface friction values may be approved by the Engineer if finished slopes on the Containment Cell are less than 3 horizontal:1 vertical.

PART 3: EXECUTION

3.1 GENERAL

A. The work shall be coordinated with placement of the HDPE geomembrane and anchor trench backfill. The cap drainage layer shall be placed directly above the HDPE geomembrane.

B. Prior to placement of the cap drainage layer, the portion of the geomembrane to be covered by the geonet/geotextile composite shall have all required documentation complete. The surface of the geomembrane shall not contain stones or excessive dust that could cause damage.

C. The composite drainage layer shall be cut, if necessary, using an approved cutter. Care must be taken to protect underlying geomembrane if the geonet or geotextile is being cut in place.

D. Equipment used to deploy the composite drainage layer shall not damage the materials or the underlying geomembrane.

3.2 COMPOSITE DRAINAGE LAYER

A. The Contractor shall keep the composite drainage layer clean and free from debris. Soils and debris shall be cleaned by the Contractor just prior to installation, as determined by QA Representative. The Contractor shall handle all rolls in a manner to ensure they are not damaged in any way. To prevent folds and wrinkles, tension should be kept on the materials. Materials shall not be placed across side slopes. Geotextile side of the composite shall be placed facing up.

B. In the presence of winds, the composite drainage layer shall be weighted with sandbags, as necessary. The Contractor shall be responsible for damage caused by wind.

C. Adjacent geonet rolls shall be overlapped at least 6-inches and secured by plastic ties approximately every three (3) feet along the roll length. Plastic ties shall be white or another bright color for easy inspection. Metallic ties shall not be allowed. The heads of the ties must fit completely into the geonet channel space so that the head of the tie does not intrude into or against the primary liner. Adjacent pieces of composite drainage layer shall have their top geotextile components lystered together after the geonet is connected and accepted by QA Representative.

D. Horizontal seams shall not be placed on side slopes greater than 5% unless approved by QA Representative in the panel placement plan.

E. Repair

Patching of the composite shall be used to repair holes, tears, and defects. Patches shall provide 6" of overlap around the repaired area and shall be held in place with plastic ties. Composite shall be removed if areas with large defects are observed. QA Representative shall determine the acceptability of the composite drainage layer.

3.3 DRAINAGE LAYER EDGE DRAIN

A. The four (4)-inch diameter perforated polyethylene pipe shall be placed in the anchor trench following placement of the cap geomembrane and geotextile wrap. The Contractor shall place the pipe in a manner which ensures underlying materials are not damaged. Edge drain shall be continuous with outfalls located no greater than 200 ft apart. Details of the pipe can be seen on Sheet 11.

B. Pea gravel fill shall be placed around the pipe for drainage. Pea gravel fill shall be placed by the Contractor in a manner which ensures surrounding materials are not damaged. Pea gravel fill shall be placed to provide proper support for the overlying trench backfill. The QA Representative shall monitor fill placement.

3.4 OUTFALLS

Cap drain outfalls shall be installed at the locations shown on Sheet 5 and in accordance with the detail on Sheet 11.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Measurement for payment for the composite drainage layer will be based on the actual number of square yards of covered surface area in-place.

The cap drainage layer edge drain shall be measured as lineal feet in-place and shall include required granular fill, perforated pipe, pipe fittings, geotextile and cap drain outfalls.

Granular fill will not be measured and will be considered incidental to pipe placement.

4.2 PAYMENT

All prices shall include, but will not be limited to, submittals, testing, material manufacture, packaging, delivery, and storage; deployment, patches, seams, overlaps, repairs; and cleanup.

All work associated with furnishing and hauling material will not be paid separately but shall be included in the work required, or as approved by the Resident Engineer. No additional payment will be made for removing approved materials which are rendered unsuitable after placement or replacement or for removal, hauling, disposal and replacement of objectionable materials.

The completed work as measured for the cap drainage layer shall be paid for according to the unit price schedule.

PAY ITEM	PAY UNIT
Composite Drainage Layer	Square yard
Edge Drain (complete)	Linear foot
Edge Drain Outfall	Each

END OF SECTION

SECTION 02755

CAP BARRIER LAYER

PART 1: GENERAL

1.1 DESCRIPTION

The Work covered by this section includes furnishing the materials, equipment, labor and expertise required to supply, fabricate and install the high density polyethylene liner (HDPE) component of the containment cell cap barrier layer and the underlying non-woven geotextile.

1.2 RELATED SECTIONS

A. Section 01050 - Field Engineering

B. Section 01300 - Submittals

C. Section 01351 - Health and Safety Plan Requirements

D. Section 02210 - Earthwork

E. Section 02715 - Water Management During Construction

F. Section 02751 - Cap Drainage Layer

1.3 REFERENCES

ASTM D638 -	Test Method for Tensile Properties of Plastics
ASTM D746 -	Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D792 -	Test Method for Specific Gravity (Relative Density) and Density of Plastics by Displacement
ASTM D1004 -	Test Method for Initial Tear Resistance of Plastic Film and Sheeting
ASTM D1204 -	Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
ASTM D1238 -	Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer

ASTM D1505 -	Test Method for Density of Plastics by the Density-Gradient Technique
ASTM D1603 -	Test Method for Carbon Black in Olefin Plastics
ASTM D1682 -	Test Method for Strip Tensile Strength
ASTM D1693 -	Test Method for Environmental Stress Cracking of Ethylene Plastics
ASTM D2663 -	Test Method for Rubber Compounds-Dispersion of Carbon Black
ASTM D3015 -	Standard Practice for Microscopical Examination of Pigment Dispersion in Plastic Compounds (NSF Modified)
ASTM D4354 -	Standard Practice for Sampling of Geosynthetics for Testing
ASTM D4437 -	Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes
ASTM D4533 -	Test Method for Trapezoid Tearing Strength of Geotextiles
ASTM D4595 -	Test Method for Tensile Properties of Geotextiles by Wide Width Strip Method
ASTM D4716 -	Test Method for Constant Head Hydraulic Transmissivity of Geotextiles and Geotextile Related Products
ASTM D4759 -	Standard Practice for Determining the Specification Conformance of Geosynthetics
ASTM D4833 -	Test Method for Index Puncture of Geotextiles, Geomembranes and Related Products
ASTM D5084 -	Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials using a Flexible Wall Permeameter
ASTM D5321 -	Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method

GRI Test Method GM6 - Pressurized Air Channel Test for Dual Seamed Geomembranes
NSF Standard 54(1991) Flexible Membrane Liners

1.4 SUBMITTALS

A. Bid Submittal

The Manufacturer and Contractor shall submit proof of qualifications with bid documents. These Submittals shall include the following:

1. Manufacturer: The Manufacturer shall submit a Quality Control Manual, a list of material properties, and a list of completed facilities totaling 5,000,000 square feet (list should specify facility name, location, date of installation, owner name, designer, Contractor, as well as the name and telephone number of a contact at the facility who can discuss the project).

The manufacturer shall also provide a minimum ten (10) year material warranty.

2. Contractor: The Contractor shall submit certification that the Installation Supervisor and Master Seamer have reviewed the Construction Drawings, the Construction Quality Assurance Plan and these Specifications. The Contractor shall also submit a copy of the Manufacturer's approval letter or license, qualifications resumes for the Installation Supervisor and Master Seamer, proposed seaming method descriptions, detailed quality control procedures and a list of completed facilities totaling 1,000,000 square feet each of polyethylene geomembrane (list should specify facility name, location, Manufacturer, date of installation, designer, and the name and telephone number of a contact at the facility who can discuss the project).

B. Post-Contract Award Submittal

After the contract award, the geomembrane Contractor shall submit a Panel Layout Plan to the QA Representative for approval. This plan shall be submitted at least two weeks prior to delivery of the geomembrane to the site.

C. Interface Testing Submittal

The Contractor shall have an independent geosynthetics testing laboratory perform shear box testing pursuant to ASTM D5321 for the interfaces and confining pressures identified in Section 02751.

1.5 PRODUCT HANDLING

Transportation and handling of the geomembrane shall be the responsibility of the Contractor. The Contractor shall provide all necessary equipment and assure that personnel are properly trained for handling of the geomembrane. Geomembrane rolls shall be stored in an area which provides protection from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat, or any other damage. Seriously damaged rolls, as determined by QA Representative, shall be rejected.

The geomembrane shall not be folded. Folded material shall be rejected.

1.6 QUALITY ASSURANCE

Quality assurance of geomembrane installation shall be performed in accordance with the enclosed Construction Quality Assurance Plan.

PART 2: PRODUCTS

2.1 RAW MATERIAL

The geomembrane shall be produced from raw materials, which may include the polymer resin, plasticizer, fillers, anti-degradants and processing aids. The resin used in production of the HDPE geomembrane shall meet the following requirements:

TEST	METHOD	REQUIREMENT	NOTES
SPECIFIC GRAVITY	ASTM D1505	>0.940	1 & 2
MELT INDEX	ASTM D1238	<0.4 g/10 min.	1 & 2 (Condition E Max)
CARBON BLACK CONTENT	ASTM D1603	2 to 3%	2

(1) Measure prior to adding carbon black.
(2) Test shall be performed at a rate of at least 1 per resin batch.

2.2 GEOMEMBRANE ROLLS

A. The geomembrane used at the site shall be a textured 60 mil high density polyethylene (HDPE). HDPE rolls shall meet the following requirements:

1. Condition: The geomembrane surface shall not have striations, roughness, pinholes, bubbles, staple marks, folds, or any other damage.

2. Properties: The geomembrane, as delivered to the site, shall meet the following physical and index property requirements or the manufacturer's minimum published values, whichever is more restrictive. Adherence to this requirement shall be made a condition of the material purchase order:

Required Material Properties of HDPE

Properties	Test Method	60 mil textured
Thickness (mils), max.	ASTM D1593	60
Density (g/cc), max.	ASTM D792 or D1505	0.940
Tensile Properties	ASTM D638-NSF Modified	
1. Strength at Yield (lb/in. width) min.		130
2. Strength at Break (lb/in width), min.		243
3. Elongation at Yield (percent), min.		13
4. Elongation at Break (percent), min.		560
Tear Resistance (lb), min.	ASTM D1004	45
Dimensional Stability (% change), max.	ASTM D1204 100°C, 1 hr	+/-3.0
Puncture Resistance (lbs)	ASTM D4833	80
Carbon Black Content (%), range	ASTM D1603	2.0-3.0
Carbon Black Dispersion	ASTM D3015-NSF Modified	A1, A2

* Values obtained from NSF International Standard 54 Flexible Membrane Liners

2.3 EXTRUDATE BEADS AND/OR ROD

All extrudate shall be compatible with the HDPE geomembrane specified. Extrudate shall be from the same Manufacturer and of the same resin type as the geomembrane rolls.

2.4 GEOTEXTILE

The geotextile to be placed beneath the geomembrane on top of the soil shall be a non-woven material conforming to the following requirements.

Properties	Test Method	Required Value
Grab Strength (lbs.), min.	ASTM D4632	200
Puncture Strength (lbs.), min.	ASTM D4833	100
Tear Strength (lbs.), min.	ASTM D4533	80
Mass per Unit Area (oz/sy), min.	ASTM D3776	8

PART 3: EXECUTION

3.1 PREPARATION

Contractor and QA Representative shall inspect the surface of the stabilized soil prior to placement of the geotextile. The surface shall be dry, and free of sharp stones or protruding objects. The surface have been roughed using raking or other methods acceptable to the QA Representative.

3.2 GEOMEMBRANE ROLL CONFORMANCE

The Contractor shall have an independent laboratory perform confirmatory testing of the HDPE geomembrane rolls. Test shall include density (ASTM D792 or D1505, thickness (ASTM D1593), tensile characteristics (ASTM D638-NSF Modified), tear resistance (ASTM D1004), dimensional stability (ASTM D1204) and carbon black content (ASTM D1603). A roll shall be considered a production unit and a shipment to the site shall be a lot. Conformance shall be determined in accordance with ASTM D4759 once for every 100,000 sf of material installed.

3.3 GEOMEMBRANE AND GEOTEXTILE PLACEMENT

A. Panel Layout

1. A field panel is the unit area of geomembrane which is to be seamed in the field, i.e., a field panel is a roll or a portion of a roll cut in the field.

2. At least four (4) weeks prior to construction, the Contractor shall provide the QA Representative with drawings of the area to be covered showing the orientation of all geotextile and geomembrane panels (i.e., panel layout plan). In general, seams shall be oriented parallel to the slope, i.e., oriented along, not across, the slope. Whenever possible, horizontal seams shall be located not less than five (5) feet from the toe of slope. In corners and odd-shaped geometric locations, the number of field seams shall be minimized.

3. Each panel shall be given an "identification code" (numeric or alpha-numeric) consistent with the layout plan. This identification code shall be agreed upon by the Contractor and QA Representative. The code shall be as simple and logical as possible. Identification codes shall be used for all project records.

4. Each seam shall be given an identification code consistent with the layout plan. The seam identification system should differentiate between seam types, where possible. The seam identification system shall be compatible with the panel numbering system. The identification codes shall be used for all project records.

B. Panel Placement

1. QA Representative shall verify that panels are installed at the locations indicated in the Contractor's layout plan, as approved or modified.

2. Geotextile panels shall be installed from top of slope and adjoining panels shall be sewn together. Geotextile panels shall be installed one at a time and each panel shall be seamed immediately after its placement. Adjacent panels shall be overlapped a minimum of twelve (12) inches. The sewn seam shall consist of a prayer stitch with nylon thread. Geomembrane placement shall follow immediately behind geotextile deployment. QA Representative may allow placement of additional panels; however, all panels placed must be seamed and properly anchored by the end of the

day. The geotextile shall not be allowed to get wet. QA Representative shall record the roll number, identification code, location and date of installation for each geomembrane panel placed.

3. The Contractor shall advise the QA Representative and the RMC of any and every change in the schedule.

4. Geomembrane placement shall not proceed at an ambient temperature below 0°C (32°F) or above 40°C (104°F). Ambient temperature shall be measured approximately one (1) foot above the liner. Placement shall not be performed during any precipitation, in the presence of excessive moisture (e.g., fog, dew), in an area of ponded water, or in the presence of excessive winds. QA Representative shall be the sole judge as to whether or not placement conditions are acceptable. QA Representative shall also verify that the subgrade has not been damaged by adverse weather conditions.

C. Geosynthetic Handling - The Contractor shall assure the following during placement:

1. Any equipment or tools used shall not damage the geotextile or geomembrane by handling, trafficking, leakage of hydrocarbons, or other means.

2. No personnel working on the geotextile or geomembrane shall smoke, wear damaging shoes, or engage in other activities which could damage the materials.

3. The method used to unroll the materials shall not cause scratches, crimps, cracks, or breaks in the geomembrane and shall not damage the geotextile.

4. The method used to place the panels shall minimize wrinkles (especially differential wrinkles between adjacent panels). If warranted, intentional wrinkling of the geomembrane to compensate for expansion/contraction is allowable. Locations and dimensions of these wrinkles shall be detailed by the Contractor on the Geomembrane Layout Plan submitted to QA Representative.

5. Depressions in the compacted subgrade causing bridging by the geosynthetic cap components shall be removed or leveled by the Contractor.

6. Adequate temporary loading (e.g., sand bags) not likely to damage the geosynthetics shall be placed to prevent wind uplift.

7. Direct contact with the geomembrane shall be minimized; i.e., the geomembrane in traffic areas shall be protected by geotextiles, extra geomembrane, or other suitable materials approved by QA Representative.

D. Inspection of deployed panels:

1. QA Representative and Contractor shall inspect each panel for damage immediately after placement, but prior to seaming. Panels which are seriously damaged shall be rejected, while panels with minor damage may be allowed.

2. QA Representative shall be the sole judge as to whether panels are acceptable or must be removed. QA Representative shall record all damages and advise the Contractor as to which panels, or portions of panels, shall be rejected, repaired, or accepted.

3. Damaged panels or portions of damaged panels which have been rejected shall be marked and removed from the site by the Contractor at his own cost.

4. Repairs shall be made according to procedures described in this specification or according to Manufacturer's procedures, as approved by QA Representative.

E. Field Seaming

1. The Contractor shall ensure that adjacent panels of geomembrane are overlapped by a minimum of four (4) inches. Seams aligned across the slope shall be overlapped such that the upslope panel lies over the downslope panel.
2. Seam Preparation - Prior to seaming, the following procedures shall be followed:

   a. The seam area shall be clean and free of moisture, dust, dirt, debris of any kind, and foreign matter. Brush and wash the seam overlap portion of each panel as necessary to ensure clean contact between the panels.

b. Rolls must be laid out with no tension so that seams are aligned without wrinkles and "fishmouths".

c. For extrusion welding, grinding of the geomembrane shall be done with a hand held rotary grinder having 80 grit or finer sandpaper. Grinding shall be perpendicular, not parallel, to the seam. Overgrinding shall be avoided.

3. Weather Conditions - The following weather restrictions apply to seaming operations:

a. Seaming shall not take place during any precipitation, in the presence of excessive moisture (i.e. fog, dew, frost), in an area of ponded water or in the presence of excessive winds (unless wind barriers are provided).

b. Seaming may proceed if the geomembrane sheet temperature is above 32°F (0°C) if it can be proven via test strips that quality seams can be fabricated at lower temperatures. QA Representative shall determine the acceptability of cold weather seaming. A movable protective layer may be required below each seam overlap to prevent moisture buildup due to condensation during seaming.

c. Seaming may proceed if the sheet temperature is above 122°F (50°C) if it can be proven via test strips that quality seams can be fabricated at higher temperatures. QA Representative shall determine the acceptability of hot weather seaming. Sheet temperature should be measured by an infrared thermometer or surface contact thermocouple.

4. Test seams shall be made each day by the Contractor prior to commencing field seaming. Test seams shall be performed for each seamer working that day. These seams shall be made on fragment pieces of geomembrane liner to verify that seaming conditions are acceptable. Such test seams shall be at startups and at least once every four hours, or at the discretion of QA Representative. A field tensiometer shall be used by the Contractor to determine the peel and shear of test seams in accordance with ASTM D4437-NSF modified for 5 peel and 5 shear coupons. QA Representative shall determine the acceptability of test seams. If test seams are determined to be inadequate, appropriate corrective actions shall be taken.

5. Geomembrane seaming shall be performed by extrusion welding, extrusion flat wedge welding and/or hot wedge welding.

3.4 TESTING

A. Non-Destructive Seam Continuity Testing

1. The Contractor shall non-destructively test all field seams over their full length. The purpose of this testing is to verify seam continuity. Testing shall be done as the seaming work progresses. In addition, the Contractor shall record location, date, seam number, name of tester, and outcome of all testing. QA Representative shall monitor non-destructive seam testing.

2. The Contractor shall complete any required repairs in accordance with this specification. If repairs are required, the Contractor shall mark on the geomembrane that the repair has been made and shall document the results of non-destructive testing on the repair.

3. The following procedures shall be implemented by the Contractor at locations where seams cannot be non-destructively tested:

   a. If the seam is accessible to testing equipment prior to final installation, the seam shall be non-destructively tested prior to final installation.

   b. If the seam cannot be tested prior to final installation, acceptable seaming and cap-stripping operations shall be agreed upon between QA Representative and Contractor regarding uniformity and completeness. All such seams shall be cap-stripped with the same geomembrane.

4. Non-destructive seam testing shall be performed using either a vacuum box in accordance with ASTM D4437 or pressurized dual seam testing as outlined by GRI Test Method GM6. Other non-destructive test methods may be used, as approved by QA Representative.

B. Destructive Seam Strength Testing

1. The Contractor shall have an independent laboratory destructively test field seam samples. The purpose of this testing is to verify seam integrity.

The Contractor shall provide QA Representative with verbal results within 48 hours after seam sampling.

2. The Contractor shall submit to QA Representative one destructive seam sample per 500 feet of seam length. The exact sample location shall be selected by QA Representative. Individual samples may be taken at greater or lesser intervals. Additional destructive samples may be taken, at the discretion of QA Representative, in areas of excess crystallinity, offset welds, areas of contamination, or other visible discontinuities.

3. The sample cut shall be eighteen (18) inches wide by thirty-six (36) inches long with the seam centered lengthwise. The sample shall be cut into thirds; one section for the Contractor and two sections for QA Representative. Samples shall be cut by the Contractor under the observation of QA Representative.

4. QA Representative shall be responsible for destructive testing to assure seam integrity. Seams shall be tested by an independent laboratory for shear strength and peel adhesion. The following properties shall be required of an acceptable seam:

TEST	TYPE OF BREAK	REQUIRED STRESS
Shear Strength	FTB greater than 100% elongation ASTM 4437-NSF Modified	100 lb/in, min.
Peel Adhesion	FTB less than 30% separation ASTM 4437-NSF Modified	75 lb/in, min. (Fusion)

5. Ten one (1)-inch wide replicate specimens shall be cut from the twelve (12)-inch wide sample. Five specimens shall be tested for shear strength and five for peel adhesion. All specimens must meet minimum strength requirements and at least four of the five samples for each test must fail outside of the seam area and meet the aforementioned requirements.

6. All holes in the geomembrane resulting from seam sampling shall be immediately repaired. Patches shall be vacuum tested to assure continuity.

7. The following procedures shall apply whenever a seam sample fails a destructive test. The Contractor has two options:

   a. Reconstruct the seam between the failed location and any passed test location.

   b. Retrace the welding patch to an intermediate location (at a minimum distance of ten (10)-feet from the failed test location) and take a eighteen (18)-inch by twelve (12)-inch sample for an additional destructive seam test. If this sample passes the destructive seam test, then the seam shall be reconstructed or cap stripped between the passed locations. If this sample fails, then the process shall be repeated.

   c. Cap strip the seam between the failed location and the closest adjacent passing test location.

   d. In any case, all acceptable reconstructed seams shall be bounded by two passed test locations (i.e., the above procedure shall be followed in both directions from the original failed location). For long lengths of reconstructed or cap stripped seam, QA Representative shall take additional destructive seam samples.

3.5 DEFECTS AND REPAIRS

A. All seams and non-seam areas of the geomembranes shall be evaluated by the Contractor and QA Representative for identification of defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of inspection. The geomembrane surface shall be broomed or washed by the Contractor if the amount of dust or mud inhibits inspection.

B. Each suspect location in seam and non-seam areas shall be non-destructively tested using the methods detailed in this specification. Each location which fails non-destructive testing shall be marked and repaired by the Contractor. QA Representative shall verify markings and repairs.

C. Repair procedures are as follows:

   1. Defective seams shall be repaired by reseaming or applying a cap strip.

2. Tears or pinholes shall be repaired by extrusion welding or patching.

3. Blisters, larger holes, undispersed raw materials, and areas contaminated by foreign matter shall be repaired by patches.

4. Cap strips shall be at least six (6) inches wide and must be centered over the repair location. Cap strips shall be of the same material as the geomembrane.

5. Patches shall be round or oval in shape, made of the same materials as the geomembrane, and extend a minimum of six (6) inches beyond all edges of the defect. Patches shall be applied using extrusion fillet welding or other technique approved by QA Representative.

6. Repairs shall be numbered and logged by QA Representative and Contractor. Logging shall include repair type, welding machine used, welder, location, date of repair and details of non-destructive and/or destructive seam evaluation.

D. Each repair shall be evaluated using non-destructive testing, as described in this specification. Repairs which pass non-destructive testing shall be considered adequate. Repairs which fail non-destructive testing shall be redone and retested until a passing test is achieved. Destructive testing of long lengths of cap strips shall be performed as determined by QA Representative.

3.6 GEOMEMBRANE ACCEPTANCE

A. The Contractor shall retain all ownership and responsibility for the geomembrane until acceptance by RMC. The geomembrane shall be accepted by RMC when all of the following apply:

1. Geomembrane installation is finished.

2. All required documentation of installation is completed by the Contractor and QA Representative's certification report is completed.

3. Material conformance and destructive seam testing is completed.

4. Verification of the adequacy of all field seams and repairs, including associated testing, is completed.

5. The Contractor shall provide a final certification stating that installation has proceeded in accordance with the project specifications.

6. Written certification documents, including as-built drawings, sealed by a registered professional engineer have been received by RMC.

3.7 QUALITY ASSURANCE FOR CONTAINMENT CELL CAP SYSTEM

A. Raw Material (HDPE)

The geomembrane manufacturer is responsible for the production of geomembrane rolls from resin. Upon delivery, the following shall be furnished by the manufacturer:

1. The original resin supplier's name, resin production plant, identification (brand name/number), and productive date of the resin.

2. A copy of the quality control certificates issued by the resin supplier, noting results of density and melt index.

3. Reports on tests performed by the manufacturer to verify the quality of the resin used in the geomembrane and geonet rolls assigned to the RMC site meet the project specifications.

B. Product Certifications

The Contractor shall submit certification that all geomembrane, geotextile, and geonet rolls brought to the site meet the requirements of the specifications. For each material used at the site, the Contractor shall provide the following to QA Representative:

1. A properties sheet including specified properties and testing methods.

2. The base polymer descriptions.

3. Testing results and sample procedures from quality control testing.

4. A certification that property values given in the properties sheet are guaranteed by the manufacturer.

5. Statement certifying that no reclaimed polymer is added to the resin. Product run may be recycled, but shall only be at a proportion of 2 percent of the batch by weight.

6. Geosynthetic delivery, storage, and handling instructions.

One quality control certificate for every roll of geosynthetic used shall also be provided to QA Representative by the Contractor. This certificate shall include roll numbers and identification. The finished rolls shall be identified by a number corresponding to the particular batch of resin used. QA Representative will review all certificates for compliance with the project specifications.

The following information shall also be provided by the Contractor for any extrudate used for the project:

1. Statement of production date(s).

2. Certification stating that all extrudate is from the same manufacturer and is of the same resin type as the geomembrane seamed.

3. Copy of quality control certificates issued by the manufacturer.

C. Transportation and Handling

Geosynthetic rolls or panels shall be packaged and shipped by appropriate means so that no damage is caused.

The Contractor shall complete a Material Delivery Report (Form 1)

D. Subgrade Acceptance

1. Immediately prior to installation of the geotextile, the subbase surface shall be observed by QA Representative, Installer and Contractor. The decision to repair ruts or depressions, if any, shall be made by QA Representative. The Contractor shall repair any unacceptable subbase.

2. All recommendations and work performed on the subbase prior to installation shall be recorded. No geomembrane shall be placed on surfaces not previously found acceptable to QA Representative.

3. Surfaces to be lined shall be smooth, and free of debris, roots, and angular or sharp stones larger than 2-inch. The subbase surface shall be free from organics, trash, clayballs, sharp stones or any other deleterious material. The subbase shall be compacted in accordance with the design specifications but in no event below the minimum required to provide a firm unyielding foundation sufficient to permit the movement of vehicles and welding equipment over the subbase without causing rutting. The subbase shall have no sudden or abrupt changes in grade.

E. Anchor Trench

1. The anchor trench shall be excavated to the line, grade, and width shown on the construction drawings, prior to geosynthetic placement. The Contractor shall verify that the anchor trench has been constructed according to the project drawings.

2. The anchor trench shall be adequately drained to prevent ponding or otherwise softening of the adjacent soils while the trench is open. The anchor trench shall be backfilled by the Contractor after installation of the geotextile, geomembrane, drainage layer and perforated polyethylene pipe, as outlined in the project specifications.

F. Geomembrane Installation

1. Immediately prior to installation of the geomembrane, QA Representative shall observe the geotextile surface to insure that it is smooth, dry and free of creases, lumps and foreign objects.

2. Welding shall not take place during any precipitation, in the presence of excessive moisture, i.e., fog, dew, frost, in an area of ponded water or in presence of excessive winds (unless wind barriers are provided).

3. Seaming may proceed if the geomembrane sheet temperature is above 32°F (0°C), or if it can be proven via test strips that good seams can be fabricated at lower temperatures. QA Representative shall determine the acceptability of cold weather seaming. Sheet temperature should be measured by an infrared thermometer or surface contact thermocouple.

4. The Contractor shall be responsible for the following:

a. No equipment or tools shall damage the membrane by handling, trafficking, or other means.

b. No personnel working on the lining system shall smoke, wear damaging shoes, or engage in other activities that could damage the geosynthetics.

c. The method used to unroll the panels shall not cause scratches or crimps in the geomembrane and shall not damage the supporting soil.

d. The method used to place geomembrane panels shall minimize wrinkles. Wrinkles shall be identified as to proper location by the Installer and shall be shown on the Contractor's As-Built drawings. Ballast shall be used to prevent relocation of the compensating wrinkles by wind.

e. Bridging shall be removed.

f. Adequate loading (i.e., sandbags) shall be placed to prevent uplift by wind. (In case of high winds, continuous loading is recommended along the edges of panels to minimize risk of wind flow under the panels).

g. Direct contact with the geomembrane shall be minimized, i.e., the geomembrane in traffic area is to be protected by geotextiles, extra geomembrane, or other materials approved by QA Representative.

5. A field panel is the unit area of geomembrane which is to be seamed in the field, i.e., a field panel is a roll or a portion of a roll cut in the field. Each field panel shall be given an "identification code" consistent with the layout plan. This code should be as simple and logical as possible.

6. Field panels are installed at the locations indicated by the layout plan. Each panel placement should be recorded immediately using the daily deployment report. Identification code, location and date shall be recorded. Form 2, or a comparable equivalent, shall be used by the Contractor to evaluate panel thickness and as a record of daily deployment. All panels that are folded shall be replaced by the Installer.

7. Field Seaming

   a. The welding or seaming procedure consists of overlapping the two geomembrane sheets such that any water flowing across the seams would flow from the top panel to the underlying panel.

   b. Longitudinal seams shall be oriented parallel to the slope, i.e., oriented along, not across the slope. In corners and odd shaped geometric locations, the number of field seams should be minimized.

   c. Seams shall be aligned with the least possible number of wrinkles and "fishmouths". If a "fishmouth" or wrinkle is found, it shall be cut, removed and patched.

   d. Details of each seam, including seamer, machine number, time, and temperature shall be recorded by the Contractor on the Pre-Weld and Geomembrane Seaming Record (Form 3).

8. Pre-Weld/Trial Weld

   Pre-welds or trial welds shall be taken to verify the performance of welding equipment, seaming methods, and conditions. No seaming equipment or seamer shall be allowed to perform production welds until equipment and seamers have successfully completed trial weld(s). Pre-welds should be made in the same surroundings and environmental conditions as the production welds, i.e., in contact with the geotextile. Pre-welds shall be performed at the following frequency:

   a. At all start-ups and prior to planned shutdowns.

   b. Throughout the day as equipment requires start-up after a breakdown.

   c. At a minimum of 4 hour intervals or as directed by QA Representative.

9. Samples should be at least 2 feet long and 1 foot wide with the seam centered lengthwise. (Typically the samples are made by the welder seaming two pieces of the geomembrane together). Ten, 1-inch wide strips should be cut from the trial weld.

10. Specimens should be quantitatively tested for peel adhesion and for bonded seam strength (shear) using a recently calibrated field tensiometer. A specimen is considered to pass when the following results are achieved. (For double-wedge welding, both welds shall be tested and both shall be required to pass in peel).

    a. The break is film tearing bond (FTB).

    b. The break is ductile.

    c. The test results are consistent with test requirements established in paragraph 3.4(B) of Specification Section 02755.

11. Repeat the trial weld in its entirety when any of the trial weld samples fail in either peel and shear. When repeating trial welds fail, seaming apparatus and seamer shall not be used for production welding until deficiencies or conditions are corrected and two consecutive successful trial welds are achieved.

12. All trial welds shall be recorded by the Contractor on Form 3 (Pre-Weld and Geomembrane Seaming Record).

    a. Equipment - Extrusion fillet welders, extrusion flat wedge welders and hot wedge welders are the pieces of equipment approved for field seaming.

13. Non-Destructive Seam Testing

    Purpose of non-destructive testing is to check the continuity of the seam. The Contractor shall non-destructively test all field seams over their full length. All test equipment shall be furnished by the Contractor. Results of non-destructive testing shall be recorded on Form 4 non-destructive air pressure testing summary.

14. Destructive Seam Testing

    The purpose of destructive testing is to determine and evaluate seam integrity and assess long-term performance.

The Contractor shall provide a minimum of one destructive test sample per 500 feet of seam length from a location specified by QA Representative; individual samples may be taken at greater or lesser intervals.

Additional destructive tests may be taken in areas of contamination, offset welds, visible crystallinity or other potential cause of faulty welds, as determined by QA Representative.

All destructive seam samples shall be recorded by the Contractor on the Destructive Sample Record (Form 5). Information to be recorded includes date, sample number, seam number, machine number, seamer, date sent to lab and a summary of any field test performed.

a. Shear testing will be performed in accordance with ASTM D4437-NSF modified. This test involves peeling the sheets apart to observe how separation occurs. Results indicate whether or not the sheets are continuously and homogeneously connected through the seam.

b. Ten 1-inch wide replicate specimens shall be cut from the sample. Five specimens shall be tested for shear strength and five for peel adhesion. The test seam area will be considered acceptable if four of the five samples for each test fail outside of the seam area, provided all five samples must meet the following strength requirements:

SEAM PROPERTIES

TEST	TEST METHOD	FAILURE CRITERIA
Bonded Shear Strength (lb/in), min.	ASTM D 4437 - NSF Modified	100 (and Film Tear Bond) and >100% elongation
Seam Peel Adhesion (lb/in), min.	ASTM D 4437 - NSF Modified	90 (Fusion) and 75 (Fillet) Film Tear Bond and <30% Separation

Contractor shall document all actions taken in conjunction with destructive test failures.

15. Defects and Repairs

a. Identification - All seams and the entire geomembrane surface shall be inspected by the Contractor for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. Unacceptable panels shall be removed and replaced. Because light reflected by the geomembrane helps detect defects, the surface of the geomembrane shall be clean at the time of observation. Reflecting light will cause the surface of the geomembrane, at locations where there are imperfections, to appear white or light in color. The geomembrane surface shall be brushed, blown, or washed by the Installer if the amount of dust or mud inhibits observation, as determined by QA Representative.

b. Evaluation - Any suspect locations shall be non-destructively tested as appropriate in the presence of QA Representative. Each location that fails the non-destructive testing shall be marked by the Contractor, and repaired accordingly.

c. Repair Procedures - Any portion of the geomembrane exhibiting a flaw or failing a destructive or non-destructive test shall be repaired.

1. Defective seams shall be restarted/reseamed as described in these specifications.

2. Small holes shall be repaired by extrusion welding. If the hole is larger than 1/4-inch, it shall be patched.

3. Long lengths of failed seams shall be cap stripped.

4. Tears shall be repaired by patching. Where the tear is on a slope or an area of stress and has a sharp end it must be rounded by cutting prior to patching.

5. Blisters, large holes, undispersed raw materials, and contamination by foreign matter shall be repaired by large patches.

6. Surfaces of the geomembrane which are to be patched shall be abraded, cleaned and extrusion welded.

7. Folds shall be removed or patched.

Patches shall be round or oval in shape, made of the same geomembrane, and extended a minimum of 6 inches beyond the edge of defects. All patches shall be the same compound and thickness as the geomembrane specified. All patches shall have their top edge beveled with a grinder prior to placement on the geomembrane. Patches shall be applied using approved methods only.

All surfaces must be clean and dry at the time of repairs. All seaming equipment used in repairs must be approved by QA Representative and Contractor. All repair procedures, materials, and techniques shall be approved in advance of the specific repairs by QA Representative and Contractor.

Form 6 (FML Repair Locations) shall be completed by the Contractor to document repairs.

a. Restart/Reseaming Procedures - The welding process shall restart by grinding the existing seam and rewelding a new seam. Welding shall commence where the grinding started and must overlap the previous seam by at least two inches. Reseaming over an existing seam without regrinding shall not be permitted. Reseaming must be approved by QA Representative.

b. Verification of Repairs - Each repair shall be non-destructively tested. Repairs that pass the non-destructive test shall be taken as an indication of an adequate repair. Failed tests indicate that the repair shall be repeated and retested until passing test results are achieved. QA Representative shall take additional destructive seam samples, as necessary, for long lengths of cap stripped seam.

c. Recording of results: daily documentation of all non-destructive and destructive tests shall be prepared by QA Representative. This documentation shall identify all seams that initially fail destructive testing and indicate evidence that these seams were repaired and successfully retested. Documentation shall identify all patch, bead or cap strip locations and indicate that repairs were made and successfully tested.

FORM 1

MATERIAL

DELIVERY REPORT

PROJECT NAME:
PROJECT NUMBER:
LOCATION:
DATE:
MATERIAL TYPE:

ROLL NO.	BATCH NO.	RESIN TYPE	DESCRIPTION OF DAMAGE

COMMENTS:

OFF-LOADING PROCEDURES:

MATERIAL STORAGE:

FORM 2

GEOMEMBRANE PANEL DEPLOYMENT LOG

PROJECT NAME:____________________ DATE DEPLOYED:

PROJECT NUMBER:__________________ TEMP: Max:________F; Min:________F

LOCATION:_______________________ WIND:______________ mph N S E W

ALL MEASURED IN MILS

SEAM NO.:

SEAM NO.:

SUB-GRADE ACCEPTED FOR AREA BENEATH PANEL NUMBER:

__________ Yes __________ No

REMEDIAL WORK REQUIRED:

__________ Yes __________ No

	TYPE OF WORK REQUIRED:	

REMEDIAL WORK COMPLETED AND AREA ACCEPTED:

__________ Yes __________ No

COMMENTS:	

PANEL NUMBER:________________

PANEL LENGTH:________________

ROLL NUMBER:________________

FORM 3

PRE-WELD AND GEOMEMBRANE SEAMING RECORD

PROJECT NAME:
PROJECT NUMBER:
LOCATION:
DATE:
CQA MONITOR:

WELDING MACHINE NUMBER:__________ WELDER'S NAME:

Pre-weld Seam #	Time am/pm	Temp.	Temperature of		Results		Pass/ Fail*
			Welder	Extrudate	Peel	Shear	

COMMENTS:

NOTE: USE ONLY ONE FORM PER WELDER.

* PASS OR FAIL RESULTS ARE FOR PRE-WELDS ONLY, TEST RESULTS FOR SEAMS ARE DOCUMENTED ON FORMS 4 AND 5.

FORM 4

NON-DESTRUCTIVE AIR PRESSURE SEAM TESTING

PROJECT NAME:
PROJECT NUMBER:
LOCATION:

SEAM NUMBER	CQA	TIME	PSI	DATE	TIME	PSI	PASS/ FAIL *

* REPAIRS OF FAILED SEAMS ARE DOCUMENTED ON FORM 5

** EXTRUSION WELDED

FORM 5
DESTRUCTIVE SAMPLE RECORD

PROJECT NAME:
PROJECT NUMBER:
LOCATION:

DATE	DS NO.	SEAM NO.	MACH NO.	OPER NAME	FIELD TEST		DATE TO LAB PKG SLIP NO. FEDEX/UPS
					PEEL	SHEAR	

FORM 6

FML REPAIR FORM

REPAIR DESIGNATION	DATE DAMAGE OBSERVED	DATE REPAIR CONDUCTED	SIZE	LOCATION OF REPAIR	REPAIRED TEST DATE	RESULT

END OF SECTION

SECTION 02831

FENCING

PART 1: GENERAL

1.1 DESCRIPTION

The work covered by this section shall include the installation of Site security fencing to replace fencing removed during the Work and the installation of security fence along the RMC property boundary adjacent to the CSX right-of-way. The Contractor shall provide all expertise, supervision, labor, materials, and equipment necessary to complete the work as required by the CM Design Report, as detailed on the Drawings and as specified herein.

1.2 RELATED SECTIONS

A. Section 01010 - Summary of Work
B. Section 01050 - Field Engineering
C. Section 01300 - Submittals
D. Section 01351 - Health and Safety Plan Requirements
E. Section 02110 - Site Clearing and Grubbing

1.3 REFERENCES

CLFMI - Chain Link Fence Manufacturer's Institute. Voluntary Standards for Chain Link Fence Installation

1.4 SUBMITTALS

The Contractor shall submit manufacturer's installation instructions and material specifications including standard details to the QA Representative for review and approval prior to any fence installation. The Contractor shall also submit the installation subcontractor's qualifications and proof of insurance.

PART 2: PRODUCTS

2.1 SECURITY FENCING

A. Fabric

The fabric of the security fencing shall consist of No. 9 gauge (0.148 inch) finished steel wires, 2-inch mesh with top and bottom salvages twisted and barbed. The fabric height shall be 60 inches. 3-strand barbed wire shall be provided and installed at the top of the security fence.

B. End, Corner, and Pull Posts

Posts shall be 2.375-inch OD steel pipe weighing 3.65 pounds per lineal foot, or 3.5-inch by 3.5-inch roll-formed sections, 4.85 pounds per lineal foot.

C. Line Posts

Line posts shall be spaced 10 feet on center maximum, unless otherwise indicated. Posts shall be 2.375-inch OD steel pipe, 3.65 pounds per lineal foot.

D. Top Rail

The top rail shall be manufacturer's longest length with expansion-type couplings, approximately six inches long, for each joint. The Contractor shall provide means for attaching the top rail securely to each corner, pull, and end post. The top rail shall be 1.66-inch OD pipe, 2.27 pounds per lineal foot, or 1.625-inch by 1.25-inch roll-formed sections, 1.35 pounds per lineal foot.

E. Tension Wire

The tension wire shall be 7 gage, coated coil spring wire, metal type and finish to match fabric. Tension wire shall be located at bottom of fabric only.

F. Post Tops

Post tops shall be weather-tight closure cap (for tubular posts), one cap for each post. Caps shall be furnished with openings to permit passage of top rail and with stands for the installation of the barbed wire.

G. Stretcher Bar

Stretcher bars shall be one piece lengths equal to the full height of fabric, with a minimum cross-section of 13/16-inch by ¾-inch. One stretcher bar shall be provided for each gate and end post, and two for each corner and pull post, except where fabric is integrally woven into post.

H. Stretcher Bar Bands

The Contractor shall provide stretcher bar bands which shall be spaced at not more than 15 inches on-center (o.c.), to secure stretcher bars to end, corner, pull, and gate posts.

I. Wire Ties

For tying fabric to line posts, the Contractor shall use wire ties spaced one foot o.c. For tying fabric to rails and braces, the Contractor shall use wire ties spaced two feet o.c. For tying fabric to tension wire, the Contractor shall use hog rings spaced 2 feet o.c.

Manufacturer's standard tying or connection procedures shall be accepted if of equal strength and durability.

J. Galvanized Finish

The fabric shall be galvanized with not less than 2.0 ounce zinc per square foot of surface. The framework shall be galvanized steel with not less than 1.8 ounce zinc per square foot of surface. Hardware and accessories shall be galvanized.

K. Concrete

Concrete for post anchorage shall obtain a minimum 28-day compressive strength of 2,500 pounds per square inch (psi) using at least four sacks of cement per cubic yard, contain 1-inch maximum size aggregate.

2.3 WARNING SIGNS

Warning signs shall be at least 2 ft by 2 ft and shall be constructed of durable weather resistant material with white background and red lettering. Warning signs shall be printed in English and Spanish and shall read as follows:

WARNING! (2")
NO TRESPASSING (2")
DO NOT DISTURB SOIL (2")
FOR INFORMATION (1")
(610) 921-4054 (1")

PART 3: EXECUTION

3.1 INSTALLATION

A. General

The Contractor's Surveyor shall locate property boundary along common property lines between RMC and CSX and Citizens Gas, and stake alignment of proposed fence to coincide with property line. Contractor shall complete necessary clear and grading along the fence alignment before beginning installation, unless otherwise permitted by the QA Representative. Replacement fence shall coincide with original alignment. The Contractor shall install the fence fabric and related hardware in compliance with this Specification and manufacturer's instructions. Installation shall be coordinated with the QA Representative.

B. Security Fence Posts

Excavation for the posts shall be to the depth required by local building code or at least 30 inches below finished grade, whichever is greater. Posts shall be placed and aligned in the center of the holes, six inches above the bottom and set in concrete. Vertical and top alignment should be checked for each post or sleeve and held in place during placement and finishing. Location of existing utilities along the path of the fence shall be located and marked in the field prior to installation and any conflicts identified in writing to the QA Representative.

C. Warning Signs

Warning signs identified in Section 2.3 shall be installed at sections of fence along Big Four Road, South Arlington Avenue and the CSX right-of-way, such that the center of the sign is 56 inches above ground surface and shall be capable of being seen at least 75 feet away. A sign shall be installed on the interior side of fencing every 100 linear feet. Signs shall be installed facing outward.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Fencing shall be measured as lineal feet in place. Signs shall be measured as number installed.

Grading, clearing and grubbing required for erection of the fence shall be considered incidental to the work.

4.2 PAYMENT

Security fencing placed in accordance with the Drawings and Specifications shall be paid according to the approved unit price schedule for the length in place. Signs placed in accordance with the Drawings and Specifications shall be paid for at the approved unit price schedule for the number in place.

PAY ITEM	PAY UNIT
Security Fence	Lineal Foot
Warning Signs	Each

SECTION 02936

SITE RESTORATION

PART 1: GENERAL

1.1 DESCRIPTION

The work covered under this section shall include stabilizing those areas disturbed directly or indirectly by the corrective measures construction including restoring excavation areas in the drainage ditches along South Arlington Avenue with sod, restoring the drainage ditches along the CSX railroad right-of-way and on-site with aggregate, restoring the excavation area south of the Citizens Gas fence line with turf, and restoring the on-site areas with either crushed aggregate or turf as designated on Sheet 9 of the design drawings including turf establishment on containment cell.

The Contractor shall provide all labor, materials and equipment to prepare subgrade to receive the proposed restoration. Within areas proposed for sod or turf (grass from seed) the Contractor shall secure and import topsoil, spread topsoil, fertilize, mulch, seed, water, place sod and maintain seeded and sodded areas designated until acceptance in accordance with the Contract Documents and as directed by the QA Representative. Restoration of areas with aggregate will include installing a geotextile filter fabric (where designated), providing and placing aggregate, protecting stabilized areas until final acceptance.

1.2 RELATED SECTIONS

A. Section 01050 – Field Engineering

B. Section 01351 - Health and Safety Plan Requirements

C. Section 02100 - Site Preparation

D. Section 02110 - Site Clearing and Grubbing

E. Section 02115 - Erosion and Sediment Control Measures

F. Section 02150 – Demolition of Remnant Structures

G. Section 02210 – Earthwork

H. Section 02715 – Water Management During Construction

I. Section 02720 – Site Stormwater System

J. Section 02831 - Fencing

1.4 SUBMITTALS

The following submittals are required as part of the site restoration work:

- Contractor shall submit topsoil and sod source names, location and previous land use, results of topsoil analyses, a certification that the topsoil and sod are clean and recommendations for fertilizer and lime.
- Certificates from lime and fertilizer vendors including pertinent material properties.
- Certificates from seed vendors for proposed seed mixtures including botanical and common names and proportions of seeds, purity content expressed as percentage, and germination.
- Suppliers recommendations for installation and maintenance of turf and sod including cutting method and recommended grass height, fertilizer frequency and rates, and recommendations for watering/soil moisture. Contractor shall highlight where supplier's recommendations vary from these specifications and request QA Representative approval for deviation from this specification.
- Contractor shall submit name and location of proposed quarry for aggregate including IDEM permit number and certification that aggregate source is not contaminated.
- Contractor shall submit manufacturer's material property and installation information, labels and delivery tickets for tackifier, erosion control mat, and geotextile.

1.5 QUALITY ASSURANCE

Quality Assurance shall be performed in accordance with the CQAP. The QA Representative shall ensure that work is completed in accordance with the Contract Documents.

PART 2: PRODUCTS

2.1 TOPSOIL

Topsoil shall be friable and loamy and classified as loam, silt loam, sandy clay loam, or clay loam capable of supporting good vegetative growth. Topsoil shall be free from subsoil, slag, clay, stones, lumps, live plants, roots, sticks, noxious weeds, mine spoils, and foreign matter prior to placement.

Soil analyses shall be conducted at least once for every 1,000 cubic yards of topsoil placed. Soil analyses shall consist of tests for organic content, nutrients, and pH conducted by an approved agricultural laboratory. Geotechnical testing shall consist of classification in accordance with the Unified Classification System (ASTM D2487). The Contractor shall incorporate fertilization and liming recommendations developed from the soils analyses for the topsoil. Recommendations shall include at a minimum: application rates, fertilizer type and quality, and lime type and quality specific to areas being restored with sod and areas being restored with turf. Topsoil shall have an organic carbon content greater than 2.5 percent.

Imported topsoil shall be analyzed for TAL Metals/TCL VOCs and SVOC compounds and shall be less than IDEM RISC Default Residential Standards for Direct Contact and Soil to Groundwater, whichever is more stringent. Analytical testing shall be conducted once for each borrow source, unless additional testing is requested by the QA Representative. Copies of the bills of lading for each load of imported material shall be submitted with the Contractor's Daily Reports to document the borrow source.

The submittal for each topsoil source shall include the source name, location, the prior use of the source, and a statement from the supplier that the material is not contaminated.

2.2 FERTILIZER

Fertilizer shall be commercial grade, free flowing, slow release fertilizer with 50% of the elements derived from organic sources, uniform in composition and shall conform to applicable local, state and federal regulations. Fertilizer rates and proportions shall meet the recommendations developed by topsoil analysis as required to eliminate any deficiencies in the topsoil to the following proportions: Nitrogen 20%, phosphoric acid 10%, soluble potash 10%.

2.3 SEED MIXTURE

The temporary seed mixture shall be annual rye grass or alternate proposed by the Contractor and approved by the QA Representative applied at a rate of 20 lb per acre.

The permanent seed mixture for the area south of the Citizens Gas fence, the cap and other disturbed areas designated for turf establishment shall be composed of the following species. Mix ratios may be altered based on availability of species:

- 50% Kentucky Blue Grass
- 20% Creeping Red Fescue
- 20% Integra Perennial Rye
- 10% Clover

Seed shall have a minimum pure seed content of 98% with a minimum germination of 85%. Seed shall be applied at a rate of 150 lb to 200 lbs per acre. Seed shall be furnished in original containers showing analysis of seed mixture, percentage of pure seed, year of production, net weight, date of packaging, and location of packaging. Damaged packages shall not be accepted. Seed germination shall have been tested within six months of the planting date. No seed shall be accepted with a germination test date more than six months old unless retested.

2.4 MULCH AND TACKIFIER

Mulch shall consist of dry oat or wheat straw free from weeds, foreign matter undesirable to plant life. Straw mulch shall not be chopped or finely broken (except for hydroseeding). Mulch shall be applied in combination with seed, tackifier and water using a hydraulic seeder. Mulch rate shall be 1,000 lbs/acre. Tackifier shall be a non-toxic/non-asphaltic emulsion and consist of natural vegetable gum blended with jelling and hardening agents, approved by the QA Representative. Application rate shall be 220 lbs per acre unless otherwise recommended by the manufacturer. Water shall be utilized at a rate of 4,500 gallons per acre during hydroseeding.

2.5 TURF REINFORCEMENT

Synthetic erosion control mat shall be used on the containment cell. Synthetic erosion control mat shall be similar to Tensar Mat 400, or approved equivalent, and shall have a minimum unit weight of 12 ounces per square yard.

Turf reinforcement used for all turf areas (excluding the containment cell) shall be a biodegradable fiber mat similar to Curlex NetFree or approved equivalent shall be used for all remaining turf. The material shall not have polypropylene netting.

2.6 SOD

Sod will be used to establish turf within designated stormwater swales and basins. The sod grass type shall be similar to the seed mixture specified in 2.3. Sod shall be free of weeds and undesirable coarse weedy grasses. Sod shall be machine cut at a uniform soil thickness of 1- inch (2.5 cm), plus or minus 1/4 inch (0.6 cm), at the time of cutting. This thickness shall exclude shoot growth and thatch. Pieces of sod shall be cut to the suppliers standard width and length, with a maximum allowable deviation in any dimension of 5%. Torn or uneven pads will not be acceptable. Standard size sections of sod shall be strong enough to support their own weight and retain their size and shape when suspended from a firm grasp on one end of the section. Sod shall not be cut or laid in excessively wet or dry weather. Sod shall be harvested, delivered, and installed within a period of 36 hours.

2.7 WATER

Water utilized for hydroseeding and maintenance watering shall be clean, fresh water. Watering to be performed on restored turf and sod areas not owned by RMC shall be obtained from the local public water/fire service. The Contractor will be permitted to utilize water from within the proposed stormwater management basin for watering on the RMC property when approved by the QA Representative and the Contractor can assure that the water can be removed without disturbing sediment. The Contractor will not be permitted to utilize treated water from the water treatment system.

2.8 COARSE AGGREGATE FOR RESTORATION

Coarse aggregate shall be utilized to stabilize the surface of backfilled excavation areas, drainage ditches (on-site and off-site), the perimeter access road and other disturbed site areas designated for surface stabilization with coarse aggregate. The types of coarse aggregate shall be as follows:

2.8.1 Drainage Ditch Aggregate – Coarse aggregate utilized to stabilize drainage ditches shall be imported from an off-site quarry and be a hard durable angular stone meeting the gradation requirements for AASHTO #1 Stone. Recycled concrete may not be utilized as drainage ditch aggregate.

2.8.2 Off-Site Surface Stone Aggregate – Coarse aggregate utilized for surface stone on property not owned by RMC shall be a hard durable angular stone imported from an off-site quarry and meeting the gradation of an AASHTO #3 stone.

2.8.3 On-Site Surface Stone Aggregate – On-site surface stone shall conform to the requirements established for Granular Fill as described in Specification Section 02210.

2.9 GEOTEXTILE

Geotextile placed beneath the aggregate in areas of drainage ditch restoration and access road crushed stone shall be a non-woven geotextile filter fabric material possessing a minimum grab strength of 200 lbs/in and minimum puncture strength of 90 lbs.

PART 3: EXECUTION

3.1 GENERAL

On-site and off-site drainage ditches (except within the right-of-way for South Arlington Avenue) shall be restored with aggregate. Off-site drainage ditches along South Arlington Avenue and the lawn area south of the Citizens Gas fence shall be restored with sod. Disturbed areas (besides the drainage ditch along the driveway) within the RMC property shall be restored with turf (topsoil, seed, mulch, erosion control mat and fertilizer) or on-site surface stone aggregate.

3.2 DELIVERY, STORAGE AND HANDING

3.2.1 Seed

Seed shall be delivered and stored in sealed standard containers showing analysis of seed mixture, percentage of pure seed, year of production, net weight, date of packaging and location of packaging. Seed which has become wet, moldy, or otherwise damaged in transit or in storage will not be acceptable. Damaged packages are not acceptable.

3.2.2 Fertilizer

Fertilizer shall be delivered and stored in waterproof bags showing weight, chemical analysis, and name of manufacturer.

3.2.3 Erosion Control Mat

Erosion control mat shall be stored in accordance with Manufacturer's recommendations. Damaged rolls are not acceptable.

3.3 TOPSOIL PLACEMENT

Topsoil shall be graded in accordance with the design drawings and to the satisfaction of the QA Representative. Underlying soil shall be properly graded and loosened to a depth of 2 inches before placing the topsoil. Stones and other foreign material 2 inches or larger in any dimension shall be removed. Unsuitable or surplus material shall be removed and satisfactorily disposed of by the Contractor.

Topsoil shall be placed on prepared areas and, unless otherwise indicated, spread and compacted to a 6-inch uniform depth +/- 1.5 inches. Compaction shall be with a roller weighing not over 120 pounds per foot width of roller. Topsoil shall not be placed in a wet or frozen condition or on wet or frozen subgrade.

3.4 TURF REINFORCEMENT

Turf reinforcement shall be installed in the topsoil in accordance with Manufacturer's instructions. Turf reinforcement shall secured using biodegradable stakes. Metal pins will not be permitted.

3.5 SEED BED PREPARATION

Previously placed materials shall be protected by the Contractor during seeding. Foreign materials, plants, roots, stones, and debris shall removed from the area being seeded.

The Contractor shall cultivate the ground surface to a depth of 3 inches until the soil is uniform in texture and suitable for seeding. Discing, raking, blading, or other approved methods shall be used to prepare the soil for seeding. Areas inaccessible to mechanized equipment shall be cultivated by hand. The surface of the seed bed shall conform to the established finished grades.

3.6 FERTILIZER

Fertilizer shall be applied at the rate recommended by the results of the topsoil analyses. Application shall be performed with a drill or broadcast spreader or hydraulically as a seed fertilizer slurry.

3.7 TEMPORARY SEED APPLICATION

Temporary seed shall be applied immediately at the rate identified in Section 2.3 if the area will be exposed 14 days or more. After seedbed preparation, the Contractor shall apply the specified seed mixture, fertilizer and mulch. Seed shall be sown uniformly by means of rotary seeder, cyclone seeder, drill, cultipacker seeder or hydroseeder.

3.8 PERMANENT SEED APPLICATION

After seed bed preparation, the Contractor shall apply the seed mixture in Section 2.3 within 14 days of grading completion. Seed shall be sown uniformly by means of a rotary seeder, hydraulic equipment, or other approved technique. The preferred seed application period shall be April through July; however, seed may be applied as late as September or early October. All areas disturbed by remedial activities shall be permanently seeded using specified seed types and application rates. Seeding shall be performed in accordance with the manufacturer's recommendations.

3.9 SOD INSTALLATION

Prior to laying sod, the soil surface shall be clear of trash, debris, roots, branches, stones and clods in excess of 2 inches (5 cm) in length or diameter. Sod shall not be applied to gravel or other non-soil surfaces. Any irregularities in soil surface resulting from topsoil or other operations shall be filled or leveled in order to prevent the formation or depressions or water pockets.

Areas to be sodded will be watered with a minimum of 1/2-inch (13 mm) of water unless recent rains have provided equivalent moisture. The first row of sod shall be laid in a straight line with subsequent rows placed parallel to and butting tightly against one another. Lateral joints shall be staggered to promote uniform growth and strength. Care shall be exercised to insure that sod is not stretched or overlapped and that all joints are butted tight in order to prevent voids which would cause drying of the roots. Sod shall be laid with staggered joints and be secured by pegging or other approved methods. Sod shall be installed with the length perpendicular to the slope. Begin laying sod at the bottom of the slope and work uphill. As sodding of clearly defined areas is completed, sod shall be rolled or tamped to provide firm contact between roots and soil. Turf reinforcement, or other netting may be pegged over sod for extra protection in critical areas. Sod shall be installed in the remediated areas along South Arlington Avenue. Turf establishment via seeding shall be used for vegetation in all other areas.

3.10 MULCHING

Mulch material shall be applied by the Contractor following seeding. Mulch may also be applied during hydroseeding. Mulch shall be spread uniformly over the seeded areas at a rate of 1.0 tons/acre (0.5 tons/acre if hydroseeding). The mulch shall be applied to produce a loose layer 0.75 to 1 inch deep. Mulches of hay or straw shall be tied down with liquid mulch binder at a rate of 200 to 250 gallons per acre, or synthetic binder applied in accordance with the manufacturers specifications. Binder applied through hydro-seeding shall be applied at 220 gallons per acre.

3.11 WATERING

The Contractor shall apply water as needed to maintain a continuously moist seed bed to ensure germination. Sufficient water shall be applied in the form of a fine spray to moisten the soil to a depth of three (3) inches. Surface water from creeks and ditches may not be used for this purpose. Watering shall be performed so as not to disturb seed or anchor mulch. Watering may not be required, depending on the weather conditions.

For sodded areas, after rolling sod shall be irrigated to a depth sufficient that the underside of the sod pad and the soil 4 inches (10 cm) below the sod is thoroughly wet. During the first week, in the absence of adequate rainfall, watering shall be performed as often as necessary to maintain moist soil to a depth of at least 4 inches (10 cm).

3.12 COARSE AGGREGATE SURFACE STONE RESTORATION

Surface areas designated for restoration with coarse aggregate shall be backfilled following the requirements for earthwork (Specification Section 02210) utilizing structural soil fill and granular fill as required by the CM Design and QA Representative. The final 6-inches of filling required to attain the finished grading presented on Sheet 9 shall be performed using on-site surface stone or off-site surface stone as appropriate. For the perimeter access road around the containment cell and off-site surface stone restoration areas, geotextile shall be placed between the subgrade and surface stone. On-site areas will be restored by placing on-site surface stone directly on the prepared subgrade.

3.13 PROTECTION

The Contractor shall protect restored areas against traffic and damage by erecting barricades and warning signs.

3.14 REPAIR AND MAINTENANCE

The turf and sod areas shall be subject to scheduled inspections by the RMC 30 days, 90 days, and one year after completion of the contract work. RMC may also perform more frequent inspections as deemed necessary based on factors such as weather and success of vegetation. If, during the course of these inspections, any portion(s) of the seeded areas are found to be unsatisfactory (areas of erosion, thin vegetative coverage or no coverage) to RMC, the areas shall be repaired and re-seeded by the Contractor as originally specified, at no additional expense to RMC.

The Contractor shall guarantee at least 90 percent surface area coverage of live, growing species from the seed mix applied for a period of one (1) year following the date of completion of work, with the largest individual surface area not meeting the 90 percent coverage requirement not to exceed 100 square feet. Areas not fulfilling this requirement shall be prepared and re-seeded at the expense of the Contractor. Areas disturbed by re-seeding shall also be re-seeded at the Contractor's expense using the seed mix specified in this specification, unless alternate seed mix is approved by the QA Representative.

The following maintenance shall be completed to establish and maintain the permanent vegetative cover:

1. Apply sufficient water to ensure uniform seed germination. The water shall be applied slowly to avoid puddling and crusting of the topsoil.

2. Add topsoil where necessary, including areas affected by erosion, to maintain a uniform surface at the design grade.

3. Reseed damaged areas showing root growth failure, deterioration, bare or thin spots, and eroded areas and apply sufficient water to ensure uniform germination.

4. Perform mowing and fertilization at 3 month intervals during the growing season including a final mowing and fertilization within 2 weeks of the final one year inspection. For sodded areas mowing shall not be attempted until the sod is firmly rooted (typically 2-3 weeks).

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Topsoil, of the specified 6-inch depth, shall be measured by area in square yards. Topsoil spread to a greater depth than specified or directed shall not be paid for but shall be considered as having been included as part of the contract unit price bid for topsoil. Turf reinforcement shall be measured by area in square yards.

Chemical fertilizer nutrient and lime will not be measured and shall be included in the unit price for seeding. Seeding shall be measured in place by area in acres. Straw mulch and binder shall be measured in place by area in acres. Watering, maintenance, repairs, mowing, re-seeding, and re-sodding shall not be measured and shall be included in the unit prices for seeding or sodding.

4.2 PAYMENT

Turf establishment items shall be paid for by RMC at the contract prices according to the following contract item units:

PAY ITEM	PAY UNIT
Topsoil	Square yard
Turf Reinforcement	Square yard
Turf Reinforcement (Net Free)	Square yard
Seeding, Mulching, Fertilizing	Acre

Sod Installation	Square Yard
Stone Drainage Ditches	Lineal Foot

Prices shall include, but will not be limited to, all labor, materials, equipment and expertise for preparation of subgrade to receive topsoil, spreading of the topsoil, installation of erosion mat, seeding or sodding, fertilizing, watering and maintaining seeded areas until acceptance in accordance with the Specifications, Drawings, or as directed by the QA Representative.

All work associated with furnishing and hauling material will not be paid separately but shall be included in the work required, and as approved by the QA Representative.

All work associated with topsoil sample analysis will not be paid separately but shall be considered included in other items of the work required for turf establishment.

Topsoil, sod, seed and mulch that washes out or blows away after it has been constructed and approved by the QA Representative for partial payment, shall be replaced by the Contractor at the Contractor's expense.

No additional payment will be made for removing approved material which is rendered unsuitable after placement or replacement; for removal, hauling, disposal and replacement of objectionable material; nor for any material placed outside of the lines and grades as shown on the Drawings or approved by the QA Representative.

END OF SECTION

SECTION 02999

DUST CONTROL AND AIR MONITORING

PART 1: GENERAL

1.1 DESCRIPTION

The work covered by this section shall include, but not be limited to furnishing, installing, and maintaining dust controls and air monitoring. The Contractor shall be responsible for all controls necessary to prevent generation of dust. The quantity and type of dust control measures may be increased or decreased based upon actual conditions which occur during the work. Such variations in quantity shall not be considered as alterations in the details of construction or a change in the character of the work.

The Contractor shall be responsible for both Real-Time Air Monitoring and Time-Integrated Air Sampling as follows:

A. The Contractor shall provide, install, and maintain three (3) ambient air monitoring stations at the Site. The three stations shall be located as shown Sheet 4 of the design drawings. The station locations shall be placed upon platform raised 1.5 to 2 meters above the surrounding grade.

B. The Contractor shall ensure that each station is equipped to monitor for total suspended particulates (TSP) and total lead.

C. The Contractor shall be responsible for the collection and analysis of all air monitoring samples and for the delivery of those samples to the analytical laboratory.

D. The Contractor shall maintain sample logs and quality control reports for submission to the RMC on an ongoing basis during the project.

E. The Contractor shall be responsible for evaluating the results of air sampling and for informing the QA Representative and RMC of any measures including additional dust control measures which are necessary based upon those results. All results shall be submitted to the QA Representative.

F. The Contractor shall be responsible for Real-Time Air Monitoring of construction activities using a direct reading aerosol monitor.

The Contractor shall be responsible for providing electrical power for the operation of the air monitoring stations and for protecting the stations from damage and theft.

1.2 RELATED SECTIONS

A. Section 01351 - Health and Safety Plan Requirements

B. Section 02100 - Site Preparation

C. Section 02110 - Site Clearing and Grubbing

D. Section 02150 – Demolition of Remnant Structures

E. Section 02209 – Excavation/Handling/Placement

F. Section 02210 – Earthwork

G. Section 02936 – Site Restoration

1.3 DEFINITIONS

CQAP - Construction Quality Assurance Plan
TSP - Total Suspended Particulates

1.4 QUALITY ASSURANCE

Construction quality assurance shall be performed in accordance with the CQAP.

1.5 REFERENCES

40 CFR Part 50 Appendix B - Reference Method for the determination of suspended particulate matter in the atmosphere.

USEPA SW-846 - Test Methods for evaluating solid waste - physical/chemical methods.

1.6 SUBMITTALS AND QUALIFICATIONS

The Contractor who performs the air monitoring functions described in this section shall be experienced in the field of air monitoring at various sites. The Contractor shall possess a staff of chemists, industrial hygienists or environmental scientists who are capable of assessing the results of air monitoring and advising the RMC on matters related to the results of analysis.

The laboratory that will provide analytical testing of air monitoring samples shall be experienced in the analysis of such samples and shall be approved by the QA Representative.

PART 2: PRODUCTS

2.1 TIME-INTEGRATED AIR SAMPLING

2.1.1 Station Construction Materials

In constructing the air monitoring stations, the Contractor shall employ materials designed to be weather resistant, such as pressure treated lumber or steel. Construction materials shall be of adequate thickness and strength to support all possible sampling equipment and all personnel who may be involved with collection of samples or maintenance of equipment.

2.1.2 High Volume Air Sampling Stations

The Contractor shall employ air samplers of the following or similar manufacture:

A. Three (3) high volume samplers for the collection of TSP and total lead. The samplers shall be General Metal Works (GMW) Model 2310 samplers or approved alternate.

2.1.3 Air Sampling Media

Samples to be tested for lead and TSP shall be collected on USEPA-approved borosilicate glass fiber filters.

2.2 REAL-TIME AIR MONITORING

The Contractor shall monitor for TSP using a direct reading aerosol monitor.

2.3 WIND DATA

Contractor shall provide and operate an on-site meteorological station capable of measuring and recording wind direction and speed. Results of the wind measurements will be submitted with the corresponding results.

2.4 DUST CONTROL MEASURES

Dust control measures shall include potable water, stockpile covers, mulch, or spray adhesives. Decontamination water shall be used for dust control only in contaminated areas. Mulch shall meet the requirements of Section 02936. The use of spray adhesives must specifically be approved by the QA Representative through the submittal process prior to on-site use.

PART 3: EXECUTION

3.1 RELATIONSHIP TO WORKER HEALTH AND SAFETY PROGRAM

Ambient air monitoring as described herein shall not be considered a substitute for air monitoring activities related to the health and safety of site workers.

3.2 DUST CONTROL

Dust control shall be conducted throughout the Site during all phases of work to prevent the presence of visible dust. The condition of no visible dust shall be maintained at all times. The QA Representative shall have the authority to stop work at any time if visible dust is present or if performance standards are exceeded. Work may not proceed until dust control measures are implemented to the satisfaction of the QA Representative at no additional cost to the RMC for either the additional dust control or the stoppage of work. Dust control measures shall be applied periodically throughout each work day throughout the Site. Dust control measures shall be applied to disturbed contaminated areas, including excavations and placed waste, at the end of each work day. Dust control may be conducted by sprinkling with potable water in non-contaminated areas, until the surface is wet. Dust control shall be conducted by the Contractor to the satisfaction of QA Representative at no additional cost to the RMC.

3.3 TIME-INTEGRATED AIR SAMPLING

3.3.1 Construction of Monitoring Stations

The Contractor shall provide and install high volume particulate samplers mounted on a stable base, 1.0 to 1.5 meters above the ground surface. The Contractor shall ensure that the stations are supplied with electric current.

3.3.2 Fixed Ambient Air Monitoring for Total Lead

Total lead sampling shall be performed for a minimum of three (3) days prior to commencement of work, in order to establish baseline conditions. Thereafter, total lead sampling shall be performed daily for each work phase with potential for release lead impacted of dust. Work phases that have a potential for significant release of dust include demolition, clearing/grubbing, soil/waste/sediment excavation, waste placement and restoration grading. Samples shall be collected with high volume air samplers for a 24-hour period.

Analysis of the high volume samples will be performed on a rush basis (3 to 5 days). If analytical results from the first three days of sampling of each phase of work are below one-half the target levels, then the sampling and analysis frequency will be reduced to once per week, and samples collected after 3 days but prior to receiving initial data do not need to be analyzed. If the results exceed one-half the action levels, then sampling and analysis will continue on a daily basis. Any discrepancy on the need to collect air monitoring samples for a given day or activity shall be resolved by the QA Representative.

The target level for lead in dust is 0.15 µg/m^3 based on a 90 day rolling average as calculated for each TSP monitoring location. In addition, the maximum average weekly (based on 7-days) target level will be 0.5 µg/m^3. The 90 day rolling average and weekly averages will be calculated by the QA Representative using the results of the laboratory sampling

If the total lead level in any of the daily samples exceeds 0.5 µg/m^3, the Contractor shall immediately take the necessary measures to reduce lead level. The Contractor is responsible for ensuring that target levels are achieved.

3.3.3 Sampling Equipment and Media

Samples for analysis of TSP and total lead will be collected with high volume sampling stations using bososilicate glass fiber filters.

3.3.4 Calibration Procedures and Frequency

The sampling equipment shall be calibrated at the beginning of the project and weekly thereafter. High volume samplers shall be calibrated according to the manufacturer's recommendations.

3.3.5 Analysis Method

Preparation and analysis of samples for total lead analysis will be conducted in accordance with USEPA/RCRA SW-846 Methods for Inductive Coupled Plasma Atomic Emission Spectroscopy (Method 6010).

Preparation and analysis for determination of TSP will be performed gravimetrically using the USEPA Reference Method in 40 CFR 50, Appendix B.

3.3.6 Sample Custody

All samples shall be handled as described in the CQAP. All TSP filters shall be folded in half and then in half again and placed individually in Ziploc bags.

A complete chain-of-custody form shall be maintained for each set of samples collected from the site. Transportation and transfer of the samples shall comply with USEPA recommended chain-of-custody protocols. Field notes shall be collected at the time of sample collection and will include any unusual conditions associated with the sample or sampling equipment.

3.4 REAL-TIME PERIMETER AIR MONITORING

Real-time air monitoring at the Site perimeter and work zone perimeter shall be performed during all phases of the work with potential for significant release of dust. Real-time monitoring at the work zone and Site perimeters shall be performed during decontamination, demolition, soil excavation, backfill, waste placement, cap installation and any other dust generating activities as determined by the QA Representative.

The QA Representative will calculate a target airborne particulate concentration (i.e., a trigger level) for down wind of the work zone based on the National Ambient Air Quality Standard (NAAQS) for lead ($0.15 \mu g/m^3$). This calculation will be performed by back calculating an allowable total particulate levels based on an average lead concentrations within the active work zone.

The Contractor shall monitor for TSP at a minimum of six locations at the perimeter of the Site every 2 hours during each work activity listed above, and shall monitor the work zone perimeter hourly during each work activity.

If real-time TSP monitoring results at the Site perimeter exceeds the trigger level, the Contractor shall stop work and initiate additional dust control measures. If real-time TSP monitoring results at the work zone perimeter exceeds the trigger level, the Contractor shall initiate additional dust control measures.

3.5 FIELD RECORDS

A logbook shall be maintained by operating personnel and kept up to date at all times. The logbook shall include observations relevant to operation of the air monitoring network and shall include the results of all real-time air monitoring. This book shall include all operating days and times, calibrations, problems, and corrective actions taken, maintenance, and results. All air monitoring results shall be provided to the QA Representative with the daily QC report.

The Contractor shall provide instrumentation at the Site to determine the wind speed and wind direction. Wind speed and wind direction shall be obtained continuously. In addition, the Contractor shall obtain temperature and precipitation data on a daily basis from the nearest National Weather Service Station. All meteorological measurements will be included in the air monitoring report.

3.6 TERMINATION OF AIR MONITORING

The Contractor shall not terminate monitoring of air by high-volume or real-time methods until approved by the QA Representative.

3.7 FINAL REPORT

Contractor shall submit a final Air Monitoring Report at the conclusion of the project which shall include the results of all air sampling and analyses, meteorological measurements, real-time monitoring, equipment calibration and maintenance records and copies of the field logbook.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Air monitoring stations shall not be measured. This includes materials used in construction of the air monitoring stations and air sampling equipment.

Dust control will be considered incidental to the various work elements and will not be measured or paid separately.
Costs of testing samples shall be measured as number of tests run for each particular testing method. Air sampling media shall be considered incidental to testing.

Supplying power to the air monitoring station will not be measured and will be considered incidental to construction facilities and temporary control.

4.2 PAYMENT

Payment for construction of air monitoring stations, including fully installed air samplers, shall be in accordance with the approved Lump Sum bid. Aerosol monitors and meteorological measuring equipment shall not be paid for, but shall be considered incidental to the work.

Air sampling and laboratory analysis shall be paid for in accordance with the unit price schedule, based on the number of days indentified in the Contractor's schedule submitted with the bid. RMC will not pay for additional air monitoring or lead analysis required beyond the originally established completion date.

PAY ITEM	UNIT
Provide Air Monitoring Stations	Lump Sum
Lead Analysis	Each

END OF SECTION

ATTACHMENT C

Design Calculations

ATTACHMENT C

Design Calculations

EXCAVATION VOLUME VS CELL CAPACITY

EXCAVATION VOLUME VS CELL CAPACITY

EXCAVATION VOLUME vs CELL CAPACITY

HWMU

ID	CF	CY
WP1A	20,083	744
WP1B	2,300	85
WP1C	1,805	67
WP1D	1,196	44
WP2A	29,446	1,091
WP2B	13,342	494
WP2C	2,773	103
WP3A	1,360	50
WP3B	3,317	123
WP6A	17,912	663
WP6B	456	17
MSB1A	13,933	516
MSB1B	1,778	66
MSB2A	12,125	449
MSB2B	9,968	369
	131,796	**4,881**

ON-SITE

ID	CF	CY
DW1	12,796	474
DW2	10,938	405
ND1	4,784	177
ND2	4,963	184
NW	10,562	391
FL1	4,407	163
FL2	18,444	683
FL3	31,799	1,178
FL4A	11,041	409
FL4B	4,552	169
FL5	35,408	1,311
	149,695	**5,544**

OFF-SITE

ID	CF	CY
AA1	7,957	295
AA2	3,826	142
AA3	4,515	167
AA4	4,820	179
AA5	2,267	84
AA6	14,932	553
CSX	5,489	203
CG1	936	35
CG2	2,704	100
AMT1	1,372	51
AMT2	5,874	218
AMT3	140	5
	54,831	**2,031**

CONTAINMENT CELL WASTE CAPACITY

ELEVATION	AREA	DIFF DEPTH (FT)	VOL (CF)	CUM VOL (CF)	CUM VOL (CY)
841.5	54,149				
		1	27,441	27,441	1,016
842	55,616				
		1	57,110	84,551	3,132
843	58,604				
		1	57,110	141,661	5,247
844	55,616				
		2	104,864	246,525	9,131
846	49,248				
		2	93,048	339,573	12,577
848	43,800				
		2	82,440	422,013	15,630
850	38,640				
		2	72,408	494,421	18,312
852	33,768				
		2	62,952	557,373	20,643
854	29,184				
		2	58,368	615,741	**22,805**
856	24,888				
		2	45,768	661,509	**24,500**
858	20,880				
		1	19,932	681,441	25,239
859	18,984				
		1	11,092	692,533	**25,649**
860	3,200				
		1	800	693,333	**25,679**
860.5	0				

TOTAL CELL CAPACITY **25,679 CY**

SOIL LOSS CALCULATIONS

SOIL LOSS CALCULATIONS

SOIL LOSS ESTIMATION

PURPOSE

The following calculations estimate the average soil. The first calculation represents construction of the containment cell and storm water management basin area during clearing and grubbing, soil remediation, topsoil stripping, and grading. The second and third calculations represent erosion from the containment cell cap after final grading and vegetation.

METHOD

The Universal Soil Loss Equation will be used to estimate soil loss.

A=RKLSCP

Where:

A = soil loss (tons/acre/yr)
R = rainfall factor
K = soil erodibility factor
L = slope-length factor
S = slope-gradient factor
C = cropping-management factor
P = erosion-control practice factor

REFERENCES

Values for R, K, L, S, C and P where obtained from Solid Waste Landfill Engineering and Design.

ASSUMPTIONS

1. The existing topsoil and shallow surface soils are sandy silt to silty clay loams (ML/CL).
2. To calculate the soil loss during the period while clearing and grubbing, soil remediation, topsoil stripping, and grading is being performed, we have assumed that the soil will be bare and that the duration of exposure will be 60 days (0.16 yrs). After construction of the SWM Basin outlet structures, sediment forebay, completion of the gravel access road and placement of the sod in the drainage swale and on the containment cell side slopes will be considered stable.
3. Erosion from the completed containment cell cap is calculated as an annual soil loss. The calculation is performed twice. Once for the first year following capping and once for after the first year.
4. The following parameters for the Universal Soil Loss Equation have been assumed based on the above assumptions.

   R = 175 (see attached Figure 8.13)
   K = 0.38 (silt loam)

LS (from attached Figure 8.14)

For 2 % average slopes (slope length = 400 ft), LS = 0.45
For 33% containment cell (slope length =95 ft), LS =6.0

C = 1.0 (bare soil, see Table 8.17)
C = 0.05 (newly seeded grass during first year, see Table 8.17)
C = 0.003 (Ground cover 95% as grass)
P = 0.90 (Rough irregular surface, see Table 8.18)
P = 1.0 (Landfill surface, see Table 8.18)

4. Initial disturbance area = 3.5 acres
Containment cell cap (330ft x 190ft) = 1.4 acres

CALCULATIONS

Soil Loss for Initial Disturbance Area

A = RKLSCP

A = 175*0.38*0.45*1.0*0.9 = 26.9 tons/acre/yr

Soil Loss During Period of Initial Disturbance =
0.16 yr(26.9 tons/acre/yr)*3.5 acres = **15.1 tons**

Soil Loss Rate for 33% Containment Cell Slope (First Year)

A = RKLSCP

A = 175*0.38*6.0*0.05*1.0 = 19.95 tons/acre/yr

Annual Soil Loss =
19.95 tons/acre/yr *1.4 acres tons/acre = 27.9 tons/yr

Annual Soil Loss Rate for 33% Containment Cell Slope (After Year 1)

A = RKLSCP

A = 175*0.38*6.0*0.003*1.0 = 1.20 tons/acre/yr

Annual Soil Loss =
1.20 tons/acre/yr *1.4 acres tons/acre = 1.7 tons/yr

CONCLUSION

Through the above calculations we have attempted to evaluate the period of greatest exposure to soil loss and look at the long term condition on the area of the site most susceptible to soil loss. The calculations ignore the use of soil erosion and sediment control measures and requirements for the contractor to manage storm water during the course of the work. As a result, the values obtained are considered very conservative in that they do not represent the loss of soil from the site, but rather the potential loss if the proposed controls and management provisions were not utilized.

The short term measurements include use of silt fence, internalizing draining using berms and ditches, capture and removal of storm water from active remediation areas, and sequencing work to minimize the potential for erosion and transport of soil/sediment. Long term measures consist of stabilizing the site surface with crushed concrete and stone, fore-bay area above the sediment pond to enhance sedimentation, restricted outlet structure within the SWM basin, restoration of drainage ditches within the public right-of-way with sod and internalizing nearly the entire site drainage to promote flow through the storm water management basin.

Solid Waste Landfill Engineering And Design

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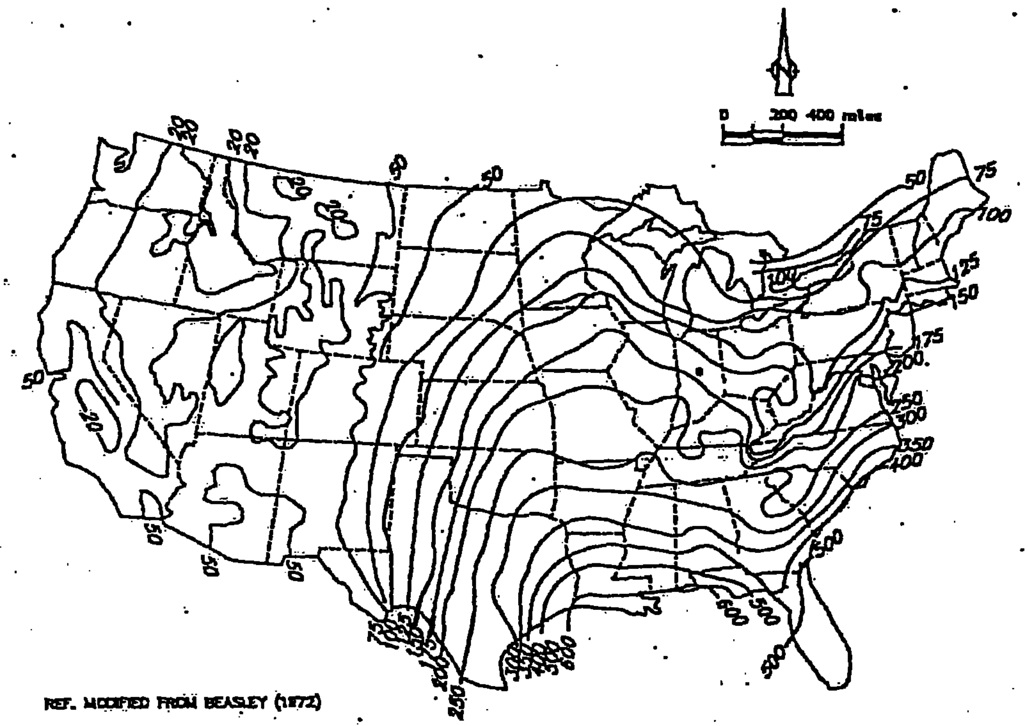

Fig. 8.13 Average annual values of the rainfall factor.
(courtesy of Iowa State University Press)

Slope-Gradient Factor, S As slopes increase, the velocity of the runoff water increases, which results in an increase in the ability of the runoff water to detach particles from the soil mass.

Values for L and S may be taken from Figure 8.14.

Cropping-Management Factor, C The cropping-management factor, C, is the ratio of soil loss from land cropped under particular conditions, relative to that from continuously fallowed land. The factor estimates the effect of vegetative cover, soil conditions, and general management practices. On landfills, freshly covered and without vegetation or special erosion-reducing procedures of cover placement, C will usually be approximately unity. Typical values of C relevant to landfill design are noted in Table 8.17.

Erosion-Control Practice Factor, P As applied to landfills, the P factor is similar to C except that it accounts for the additional erosion-reducing effects of land management practices. Typical values relevant to landfill applications are listed in Table 8.18.

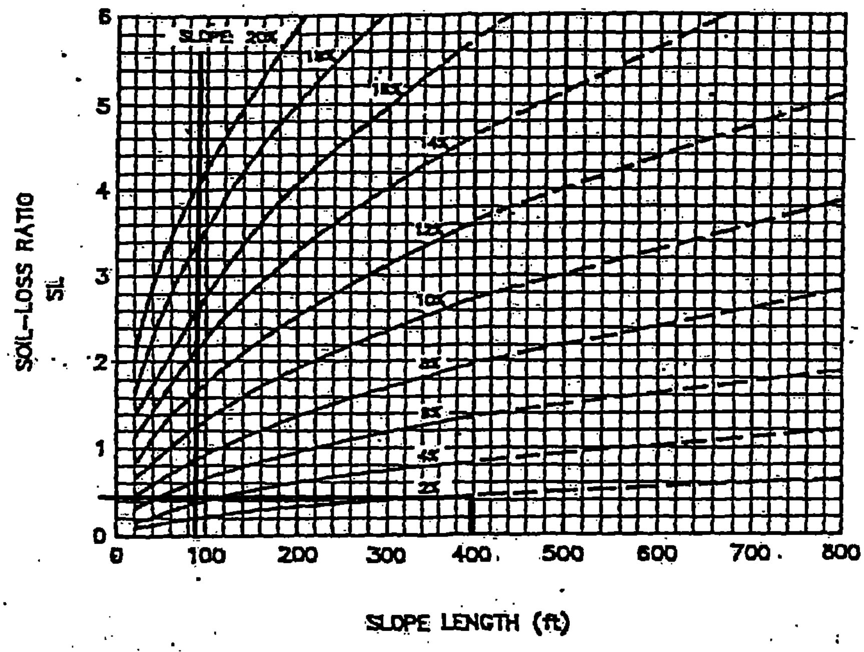

Fig. 8.14 Slope-length and slope-gradient factors. (after Beasley, 1972) (courtesy of Iowa State University Press)

In the event of erosion, it is essential that any disturbed areas be revegetated as quickly as possible, otherwise, erosion will be quickly accelerated. Velocity controls/silt traps (e.g., hay bales), erosion matting, sodded swales, lined channels, and drop pipes are all means of lowering erosion levels. Figure 8.15 illustrates a downslope flume that is used to convey the runoff rapidly down the sides of a landfill site.

8.9 WIND EROSION EFFECTS

8.9.1 Components

Dust is often a problem at landfill sites, especially in dry climates. If the soil is fine grained, it causes excessive wear of equipment, is a potential health hazard to personnel on the site, and is a nuisance to residences or businesses nearby.

Detailed computer models for calculating wind erosion losses are available, but the data and computational requirements for these models are substantial. Lutton et al. (1979) described a simple alternative model:

Table 8.17 VALUES OF *C* FOR VARIOUS CROP COVERS

Land Cover	"C" Value
Continous fallowed land	
(bare soil, no crop)	1.0
Mulch	
Heavy 1000 to 1500 lb/acre	0.2
Moderate 500 to 1000 lb/acre	0.4
Light 200 to 500 lb/acre	0.6
Grasses--	
Newly Seeded, first month	0.6
Newly Seeded, during first year	0.05
Ground cover 95-100% as grass	0.003
80% as grass	0.01
60% as grass	0.04
Permanent pasture, turf-grass	0.03

As a general guideline, ranges of soil losses (all in tons/acre/year) are as follows:

$0 < A < 5$—frequently considered an acceptable loss/year

$5 < A < 20$—sedimentation retention will be required

$A > 20$—design changes will be required (e.g., terraces or changes in slope and depth)

Table 8.18 VALUES OF P FOR VARIOUS SURFACE PREPARATIONS

Erosion Control Practice	P Value
Surface condition with no cover; compact, smooth, scraped	1.30
Landfill surface	1.00
Rough irregular surface; equipment (tracks in all directions)	0.90
Small sediment basins (1 basin for 4 acres)	0.50

STORM WATER MANAGEMENT CALCULATIONS

STORM WATER MANAGEMENT CALCULATIONS

=========================

JOB TITLE

=========================

Project Date: 3/31/2010
Project Engineer: Paul Stratman
Project Title: RMC - Beech Grove
Project Comments:

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Table of Contents (continued)

MASTER DESIGN STORM SUMMARY

Network Storm Collection: indianapolis

Return Event	Total Depth in	Rainfall Type	RNF ID
2	2.6400	Synthetic Curve	TypeII 24hr
5	3.6000	Synthetic Curve	TypeII 24hr
10	4.0800	Synthetic Curve	TypeII 24hr
25	4.8000	Synthetic Curve	TypeII 24hr
50	5.2800	Synthetic Curve	TypeII 24hr
100	6.0000	Synthetic Curve	TypeII 24hr

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
CAP DA	AREA	2	.145		11.9500	2.61		
CAP DA	AREA	5	.236		11.9000	4.27		
CAP DA	AREA	10	.284		11.9000	5.13		
CAP DA	AREA	25	.357		11.9000	6.44		
CAP DA	AREA	50	.407		11.9000	7.31		
CAP DA	AREA	100	.483		11.9000	8.63		
CAP SW BASIN IN	POND	2	.145		11.9500	2.61		
CAP SW BASIN IN	POND	5	.236		11.9000	4.27		
CAP SW BASIN IN	POND	10	.284		11.9000	5.13		
CAP SW BASIN IN	POND	25	.357		11.9000	6.44		
CAP SW BASIN IN	POND	50	.407		11.9000	7.31		
CAP SW BASIN IN	POND	100	.483		11.9000	8.63		

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
CAP SW BASIN OUT	POND	2	.144		12.0500	1.61	838.37	.031
CAP SW BASIN OUT	POND	5	.235		12.0500	2.49	838.66	.052
CAP SW BASIN OUT	POND	10	.283		12.0500	2.85	838.79	.063
CAP SW BASIN OUT	POND	25	.356		12.0500	3.27	838.99	.083
CAP SW BASIN OUT	POND	50	.406		12.0500	3.47	839.10	.097
CAP SW BASIN OUT	POND	100	.482		12.0500	3.75	839.28	.120
*OUT 20	JCT	2	1.521		12.1000	4.77		
*OUT 20	JCT	5	2.323		12.1000	6.40		
*OUT 20	JCT	10	2.733		12.1000	7.14		
*OUT 20	JCT	25	3.356		12.1500	10.04		
*OUT 20	JCT	50	3.775		12.1500	13.03		
*OUT 20	JCT	100	4.407		12.1000	16.04		
OUTLET STRUCTURE	JCT	2	1.521		12.1000	4.77		
OUTLET STRUCTURE	JCT	5	2.323		12.1000	6.40		
OUTLET STRUCTURE	JCT	10	2.733		12.1000	7.14		
OUTLET STRUCTURE	JCT	25	3.356		12.1500	10.04		
OUTLET STRUCTURE	JCT	50	3.775		12.1500	13.03		
OUTLET STRUCTURE	JCT	100	4.407		12.1000	16.04		
SITE SW BASININ	POND	2	1.376		11.9000	24.90		
SITE SW BASININ	POND	5	2.087		11.9000	37.31		
SITE SW BASININ	POND	10	2.450		11.9000	43.51		
SITE SW BASININ	POND	25	3.000		11.9000	52.78		
SITE SW BASININ	POND	50	3.369		11.9000	58.93		
SITE SW BASININ	POND	100	3.926		11.9000	68.12		
SITE SW BASINOUT	POND	2	1.376		12.2500	3.28	838.50	.594
SITE SW BASINOUT	POND	5	2.087		12.3500	4.08	838.92	.946
SITE SW BASINOUT	POND	10	2.450		12.3500	4.43	839.13	1.132
SITE SW BASINOUT	POND	25	3.000		12.2500	7.08	839.38	1.367
SITE SW BASINOUT	POND	50	3.369		12.1500	9.68	839.54	1.512
SITE SW BASINOUT	POND	100	3.925		12.1500	12.32	839.78	1.742

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
SW BASIN DA	AREA	2	1.376		11.9000	24.90		
SW BASIN DA	AREA	5	2.087		11.9000	37.31		
SW BASIN DA	AREA	10	2.450		11.9000	43.51		
SW BASIN DA	AREA	25	3.000		11.9000	52.78		
SW BASIN DA	AREA	50	3.369		11.9000	58.93		
SW BASIN DA	AREA	100	3.926		11.9000	68.12		

Title... Project Date: 3/31/2010
Project Engineer: Paul Stratman
Project Title: RMC - Beech Grove
Project Comments:

DESIGN STORMS SUMMARY

```
Design Storm File,ID =              indianapolis


Storm Tag Name       = 2
---------------------------------------------------------------------
Data Type, File, ID = Synthetic Storm    TypeII  24hr
Storm Frequency     = 2 yr
Total Rainfall Depth= 2.6400 in
Duration Multiplier =  1
Resulting Duration  = 24.0000 hrs
Resulting Start Time= .0000 hrs  Step= .1000 hrs  End= 24.0000 hrs


Storm Tag Name       =     5
---------------------------------------------------------------------
Data Type, File, ID = Synthetic Storm    TypeII  24hr
Storm Frequency     = 5 yr
Total Rainfall Depth= 3.6000 in
Duration Multiplier =  1
Resulting Duration  = 24.0000 hrs
Resulting Start Time= .0000 hrs  Step= .1000 hrs  End= 24.0000 hrs


Storm Tag Name       =    10
---------------------------------------------------------------------
Data Type, File, ID = Synthetic Storm    TypeII  24hr
Storm Frequency     = 10 yr
Total Rainfall Depth= 4.0800 in
Duration Multiplier =  1
Resulting Duration  = 24.0000 hrs
Resulting Start Time= .0000 hrs  Step= .1000 hrs  End= 24.0000 hrs


Storm Tag Name       =    25
---------------------------------------------------------------------
Data Type, File, ID = Synthetic Storm    TypeII  24hr
Storm Frequency     = 25 yr
Total Rainfall Depth= 4.8000 in
Duration Multiplier =  1
Resulting Duration  = 24.0000 hrs
Resulting Start Time= .0000 hrs  Step= .1000 hrs  End= 24.0000 hrs


Storm Tag Name       =    50
---------------------------------------------------------------------
Data Type, File, ID = Synthetic Storm    TypeII  24hr
Storm Frequency     = 50 yr
Total Rainfall Depth= 5.2800 in
Duration Multiplier =  1
Resulting Duration  = 24.0000 hrs
Resulting Start Time= .0000 hrs  Step= .1000 hrs  End= 24.0000 hrs
```

Title... Project Date: 3/31/2010
Project Engineer: Paul Stratman
Project Title: RMC - Beech Grove
Project Comments:

DESIGN STORMS SUMMARY

Design Storm File,ID = indianapolis

Storm Tag Name = 100

```
Data Type, File, ID = Synthetic Storm    TypeII  24hr
Storm Frequency     = 100 yr
Total Rainfall Depth= 6.0000 in
Duration Multiplier =  1
Resulting Duration  = 24.0000 hrs
Resulting Start Time= .0000 hrs  Step= .1000 hrs  End= 24.0000 hrs
```

```
::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
TIME OF CONCENTRATION CALCULATOR
::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

------------------------------------------------------------------------

Segment #1:  Tc: User Defined

                                         Segment #1 Time:     .0833 hrs
------------------------------------------------------------------------

                                                 ========================
                                                 Total Tc:     .0833 hrs

                                                 Calculated Tc < Min.Tc:
                                                 Use Minimum Tc...
                                                 Use Tc =      .0833 hrs
                                                 ========================
```

Tc Equations used...

==== User Defined ====

Tc = Value entered by user

Where: Tc = Time of concentration

::
TIME OF CONCENTRATION CALCULATOR
::

Segment #1: Tc: User Defined

Segment #1 Time: .0833 hrs

Total Tc: .0833 hrs

Tc Equations used...

==== User Defined ====

Tc = Value entered by user

Where: Tc = Time of concentration

RUNOFF CURVE NUMBER DATA

Soil/Surface Description	CN	Area acres	Impervious Adjustment %C	Impervious Adjustment %UC	Adjusted CN
Grass	84	1.180			84.00
Gravel	91	.166			91.00
COMPOSITE AREA & WEIGHTED CN --->		1.346			84.86 (85)

RUNOFF CURVE NUMBER DATA

Soil/Surface Description	CN	Area acres	Impervious Adjustment %C	Impervious Adjustment %UC	Adjusted CN
Impervious	98	2.185			98.00
Gravel	91	4.464			91.00
Grass	84	2.854			84.00
COMPOSITE AREA & WEIGHTED CN --->		9.503			90.51 (91)

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 2 year storm
Duration      = 24.0000 hrs     Rain Depth = 2.6400 in
Rain Dir      = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
HYG File - ID =  - CAP DA 2
Tc (Min. Tc)  = .0833 hrs
Drainage Area = 1.346 acres  Runoff CN= 85

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9286 hrs
Computed Peak Flow             =     2.73 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9500 hrs
Peak Flow, Interpolated Output =     2.61 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                 DRAINAGE AREA
              -------------------
              ID:CAP DA
              CN   =   85
              Area =       1.346 acres
              S    =   1.7647 in
              0.2S =    .3529 in

               Cumulative Runoff
              -------------------
                     1.2910 in
                       .145 ac-ft

HYG Volume...          .145 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08330 hrs (ID: CAP DA)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =     .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    18.31 cfs
Unit peak time      Tp =   .05553 hrs
Unit receding limb, Tr =   .22213 hrs
Total unit time,    Tb =   .27767 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 5 year storm
Duration       = 24.0000 hrs     Rain Depth = 3.6000 in
Rain Dir       = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir        = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
HYG File - ID =  - CAP DA 5
Tc (Min. Tc)  = .0833 hrs
Drainage Area = 1.346 acres  Runoff CN= 85

=============================================
Computational Time Increment    =   .01111 hrs
Computed Peak Time              =  11.9175 hrs
Computed Peak Flow              =     4.44 cfs

Time Increment for HYG File     =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     4.27 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
=============================================

                 DRAINAGE AREA
              -------------------
              ID:CAP DA
              CN   =    85
              Area =        1.346 acres
              S    =    1.7647 in
              0.2S =     .3529 in

               Cumulative Runoff
              -------------------
                      2.1037 in
                        .236 ac-ft

HYG Volume...             .236 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08330 hrs (ID: CAP DA)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    18.31 cfs
Unit peak time      Tp =   .05553 hrs
Unit receding limb, Tr =   .22213 hrs
Total unit time,    Tb =   .27767 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 10 year storm
Duration      = 24.0000 hrs     Rain Depth = 4.0800 in
Rain Dir      = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
HYG File - ID =  - CAP DA 10
Tc (Min. Tc)  = .0833 hrs
Drainage Area = 1.346 acres  Runoff CN= 85

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9175 hrs
Computed Peak Flow             =     5.32 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     5.13 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                 DRAINAGE AREA
              -------------------
              ID:CAP DA
              CN   =   85
              Area =        1.346 acres
              S    =   1.7647 in
              0.2S =    .3529 in

               Cumulative Runoff
              -------------------
                     2.5294 in
                       .284 ac-ft

HYG Volume...            .284 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08330 hrs (ID: CAP DA)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    18.31 cfs
Unit peak time      Tp =   .05553 hrs
Unit receding limb, Tr =   .22213 hrs
Total unit time,    Tb =   .27767 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration      = 24.0000 hrs     Rain Depth = 4.8000 in
Rain Dir      = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
HYG File - ID =  - CAP DA 25
Tc (Min. Tc)  = .0833 hrs
Drainage Area = 1.346 acres  Runoff CN= 85

============================================
Computational Time Increment    =   .01111 hrs
Computed Peak Time              =  11.9175 hrs
Computed Peak Flow              =     6.65 cfs

Time Increment for HYG File     =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     6.44 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                 DRAINAGE AREA
              -------------------
              ID:CAP DA
              CN   =   85
              Area =       1.346 acres
              S    =   1.7647 in
              0.2S =    .3529 in

               Cumulative Runoff
              -------------------
                      3.1837 in
                        .357 ac-ft

HYG Volume...             .357 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08330 hrs (ID: CAP DA)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =     .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    18.31 cfs
Unit peak time      Tp =   .05553 hrs
Unit receding limb, Tr =   .22213 hrs
Total unit time,    Tb =   .27767 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 50 year storm
Duration      = 24.0000 hrs     Rain Depth = 5.2800 in
Rain Dir      = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
HYG File - ID =  - CAP DA 50
Tc (Min. Tc)  = .0833 hrs
Drainage Area = 1.346 acres  Runoff CN= 85

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9175 hrs
Computed Peak Flow             =     7.54 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     7.31 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

              DRAINAGE AREA
              -------------------
              ID:CAP DA
              CN   =   85
              Area =       1.346 acres
              S    =   1.7647 in
              0.2S =    .3529 in

               Cumulative Runoff
              -------------------
                     3.6277 in
                       .407 ac-ft

HYG Volume...           .407 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08330 hrs (ID: CAP DA)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    18.31 cfs
Unit peak time      Tp =   .05553 hrs
Unit receding limb, Tr =   .22213 hrs
Total unit time,    Tb =   .27767 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 100 year storm
Duration      = 24.0000 hrs     Rain Depth = 6.0000 in
Rain Dir      = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
HYG File - ID =  - CAP DA 100
Tc (Min. Tc)  = .0833 hrs
Drainage Area = 1.346 acres  Runoff CN= 85

============================================
Computational Time Increment    =   .01111 hrs
Computed Peak Time              =  11.9175 hrs
Computed Peak Flow              =     8.88 cfs

Time Increment for HYG File     =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =     8.63 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
              -------------------
              ID:CAP DA
              CN   =   85
              Area =        1.346 acres
              S    =   1.7647 in
              0.2S =    .3529 in

               Cumulative Runoff
              -------------------
                     4.3025 in
                       .483 ac-ft

HYG Volume...            .483 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08330 hrs (ID: CAP DA)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    18.31 cfs
Unit peak time      Tp =   .05553 hrs
Unit receding limb, Tr =   .22213 hrs
Total unit time,    Tb =   .27767 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 2 year storm
Duration      = 24.0000 hrs     Rain Depth = 2.6400 in
Rain Dir      = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
HYG File - ID =  - SW BASIN DA 2
Tc            = .0833 hrs
Drainage Area = 9.503 acres  Runoff CN= 91

============================================
Computational Time Increment    =   .01111 hrs
Computed Peak Time              =  11.9222 hrs
Computed Peak Flow              =    25.75 cfs

Time Increment for HYG File     =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =    24.90 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                 DRAINAGE AREA
              -------------------
              ID:SW BASIN DA
              CN   =   91
              Area =        9.503 acres
              S    =    .9890 in
              0.2S =    .1978 in

               Cumulative Runoff
              -------------------
                     1.7383 in
                      1.377 ac-ft

HYG Volume...          1.376 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: SW BASIN DA)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   129.21 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 5 year storm
Duration       = 24.0000 hrs     Rain Depth = 3.6000 in
Rain Dir       = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir        = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
HYG File - ID =  - SW BASIN DA 5
Tc             = .0833 hrs
Drainage Area = 9.503 acres  Runoff CN= 91

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =    38.35 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =    37.31 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                 DRAINAGE AREA
              -------------------
              ID:SW BASIN DA
              CN   =   91
              Area =        9.503 acres
              S    =    .9890 in
              0.2S =    .1978 in

               Cumulative Runoff
              -------------------
                     2.6359 in
                      2.087 ac-ft

HYG Volume...          2.087 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: SW BASIN DA)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,           qp =   129.21 cfs
Unit peak time       Tp =   .05556 hrs
Unit receding limb,  Tr =   .22222 hrs
Total unit time,     Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 10 year storm
Duration      = 24.0000 hrs     Rain Depth = 4.0800 in
Rain Dir      = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
HYG File - ID =  - SW BASIN DA 10
Tc            = .0833 hrs
Drainage Area = 9.503 acres  Runoff CN= 91

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =    44.64 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =    43.51 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

              DRAINAGE AREA
            -------------------
            ID:SW BASIN DA
            CN    =    91
            Area =        9.503 acres
            S     =    .9890 in
            0.2S =     .1978 in

             Cumulative Runoff
            -------------------
                   3.0940 in
                    2.450 ac-ft

HYG Volume...           2.450 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: SW BASIN DA)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   129.21 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration      = 24.0000 hrs     Rain Depth = 4.8000 in
Rain Dir      = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
HYG File - ID =  - SW BASIN DA 25
Tc            = .0833 hrs
Drainage Area = 9.503 acres  Runoff CN= 91

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =    54.03 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =    52.78 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                 DRAINAGE AREA
              -------------------
              ID:SW BASIN DA
              CN   =   91
              Area =        9.503 acres
              S    =    .9890 in
              0.2S =    .1978 in

               Cumulative Runoff
              -------------------
                     3.7881 in
                      3.000 ac-ft

HYG Volume...          3.000 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: SW BASIN DA)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =     .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =    .7491)

Unit peak,           qp =   129.21 cfs
Unit peak time       Tp =   .05556 hrs
Unit receding limb,  Tr =   .22222 hrs
Total unit time,     Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 50 year storm
Duration       = 24.0000 hrs     Rain Depth = 5.2800 in
Rain Dir       = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir        = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
HYG File - ID =  - SW BASIN DA 50
Tc             = .0833 hrs
Drainage Area = 9.503 acres  Runoff CN= 91

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =    60.27 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =    58.93 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                 DRAINAGE AREA
              -------------------
              ID:SW BASIN DA
              CN   =    91
              Area =        9.503 acres
              S    =    .9890 in
              0.2S =    .1978 in

               Cumulative Runoff
              -------------------
                     4.2543 in
                      3.369 ac-ft

HYG Volume...           3.369 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: SW BASIN DA)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   129.21 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 100 year storm
Duration       = 24.0000 hrs     Rain Depth = 6.0000 in
Rain Dir       = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
Rain File -ID  =  - TypeII  24hr
Unit Hyd Type  = Default Curvilinear
HYG Dir        = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
HYG File - ID  =  - SW BASIN DA 100
Tc             = .0833 hrs
Drainage Area  = 9.503 acres  Runoff CN= 91

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =    69.59 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =    68.12 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
              -------------------
              ID:SW BASIN DA
              CN    =    91
              Area =        9.503 acres
              S     =    .9890 in
              0.2S =    .1978 in

               Cumulative Runoff
              -------------------
                      4.9572 in
                       3.926 ac-ft

HYG Volume...          3.926 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: SW BASIN DA)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =    .7491)

Unit peak,          qp =   129.21 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

REQUESTED POND WS ELEVATIONS:

Min. Elev.= 837.25 ft
Increment = .25 ft
Max. Elev.= 840.00 ft

****

OUTLET CONNECTIVITY

****

---> Forward Flow Only (UpStream to DnStream)
<--- Reverse Flow Only (DnStream to UpStream)
<---> Forward and Reverse Both Allowed

Structure	No.		Outfall	E1, ft	E2, ft
Inlet Box	R0	--->	C0	839.250	840.000
Culvert-Circular	C0	--->	TW	837.150	840.000
Orifice-Circular	O0	--->	TW	837.250	840.000
TW SETUP, DS Channel					

OUTLET STRUCTURE INPUT DATA

```
Structure ID       = R0
Structure Type     = Inlet Box
------------------------------------
# of Openings      =         1
Invert Elev.       =    839.25 ft
Orifice Area       =    8.0000 sq.ft
Orifice Coeff.     =      .600
Weir Length        =     12.00 ft
Weir Coeff.        =     2.800
K, Reverse         =     1.000
Mannings n         =     .0000
Kev,Charged Riser  =      .000
Weir Submergence   = No
```

OUTLET STRUCTURE INPUT DATA

```
Structure ID       = C0
Structure Type     = Culvert-Circular
------------------------------------
No. Barrels        =        1
Barrel Diameter    =    1.2500 ft
Upstream Invert    =    837.15 ft
Dnstream Invert    =    836.90 ft
Horiz. Length      =     25.00 ft
Barrel Length      =     25.00 ft
Barrel Slope       =    .01000 ft/ft

OUTLET CONTROL DATA...
Mannings n         =     .0240
Ke                 =     .5000  (forward entrance loss)
Kb                 =   .079159  (per ft of full flow)
Kr                 =     .2000  (reverse entrance loss)
HW Convergence     =      .001  +/- ft

INLET CONTROL DATA...
Equation form      =        1
Inlet Control K    =     .0078
Inlet Control M    =    2.0000
Inlet Control c    =    .03790
Inlet Control Y    =     .6900
T1 ratio (HW/D)    =     1.131
T2 ratio (HW/D)    =     1.291
Slope Factor       =     -.500
```

```
Use unsubmerged inlet control Form 1 equ. below T1 elev.
Use   submerged inlet control Form 1 equ. above T2 elev.

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...
At T1 Elev =     838.56 ft  ---> Flow =      4.80 cfs
At T2 Elev =     838.76 ft  ---> Flow =      5.49 cfs
```

```
OUTLET STRUCTURE INPUT DATA


Structure ID        = O0
Structure Type      = Orifice-Circular
------------------------------------
# of Openings       =        1
Invert Elev.        =    837.25 ft
Diameter            =    1.0000 ft
Orifice Coeff.      =      .600


Structure ID        = TW
Structure Type      = TW SETUP, DS Channel
------------------------------------
FREE OUTFALL CONDITIONS SPECIFIED

CONVERGENCE TOLERANCES...
Maximum Iterations=    40
Min. TW tolerance =    .01 ft
Max. TW tolerance =    .01 ft
Min. HW tolerance =    .01 ft
Max. HW tolerance =    .01 ft
Min.  Q tolerance =    .00 cfs
Max.  Q tolerance =    .00 cfs
```

REQUESTED POND WS ELEVATIONS:

Min. Elev.= 837.25 ft
Increment = .25 ft
Max. Elev.= 840.00 ft

****
OUTLET CONNECTIVITY
****

---> Forward Flow Only (UpStream to DnStream)
<--- Reverse Flow Only (DnStream to UpStream)
<---> Forward and Reverse Both Allowed

Structure	No.		Outfall	E1, ft	E2, ft
Culvert-Circular	C0	--->	TW	837.500	840.000
TW SETUP, DS Channel					

OUTLET STRUCTURE INPUT DATA

```
Structure ID       = C0
Structure Type     = Culvert-Circular
-------------------------------------
No. Barrels        =         1
Barrel Diameter    =    1.2500 ft
Upstream Invert    =    837.50 ft
Dnstream Invert    =    837.25 ft
Horiz. Length      =     72.00 ft
Barrel Length      =     72.00 ft
Barrel Slope       =    .00347 ft/ft

OUTLET CONTROL DATA...
Mannings n         =     .0240
Ke                 =     .5000  (forward entrance loss)
Kb                 =   .079159  (per ft of full flow)
Kr                 =     .5000  (reverse entrance loss)
HW Convergence     =      .001  +/- ft

INLET CONTROL DATA...
Equation form      =         1
Inlet Control K    =     .0078
Inlet Control M    =    2.0000
Inlet Control c    =    .03790
Inlet Control Y    =     .6900
T1 ratio (HW/D)    =      .000
T2 ratio (HW/D)    =     1.295
Slope Factor       =     -.500
```

```
Use unsubmerged inlet control Form 1 equ. below T1 elev.
Use   submerged inlet control Form 1 equ. above T2 elev.

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...
At T1 Elev =     837.50 ft   --->  Flow =      4.80 cfs
At T2 Elev =     839.12 ft   --->  Flow =      5.49 cfs
```

OUTLET STRUCTURE INPUT DATA

```
Structure ID       = TW
Structure Type     = TW SETUP, DS Channel
------------------------------------
FREE OUTFALL CONDITIONS SPECIFIED

CONVERGENCE TOLERANCES...
Maximum Iterations=    40
Min. TW tolerance =    .01 ft
Max. TW tolerance =    .01 ft
Min. HW tolerance =    .01 ft
Max. HW tolerance =    .01 ft
Min.  Q tolerance =    .00 cfs
Max.  Q tolerance =    .00 cfs
```

LEVEL POOL ROUTING SUMMARY

```
HYG Dir          = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
Inflow  HYG file = NONE STORED - CAP SW BASIN IN  2
Outflow HYG file = NONE STORED - CAP SW BASIN OUT 2

Pond Node   Data = CAP SW BASIN
Pond Volume Data = CAP SW BASIN
Pond Outlet Data = stormwater swale

No Infiltration

INITIAL CONDITIONS
-----------------------------------
Starting WS Elev    =   837.25 ft
Starting Volume     =     .000 ac-ft
Starting Outflow    =      .00 cfs
Starting Infiltr.   =      .00 cfs
Starting Total Qout=       .00 cfs
Time Increment      =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
====================================================
Peak Inflow      =      2.61 cfs    at   11.9500 hrs
Peak Outflow     =      1.61 cfs    at   12.0500 hrs
----------------------------------------------------
Peak Elevation   =    838.37 ft
Peak Storage =          .031 ac-ft
====================================================


MASS BALANCE (ac-ft)
-------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =        .145
- Infiltration =        .000
- HYG Vol OUT  =        .144
- Retained Vol =        .001
                 ----------
  Unrouted Vol =       -.000 ac-ft  (.021% of Inflow Volume)
```

LEVEL POOL ROUTING SUMMARY

```
HYG Dir           = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
Inflow  HYG file = NONE STORED - CAP SW BASIN IN  5
Outflow HYG file = NONE STORED - CAP SW BASIN OUT 5

Pond Node   Data = CAP SW BASIN
Pond Volume Data = CAP SW BASIN
Pond Outlet Data = stormwater swale

No Infiltration

INITIAL CONDITIONS
-----------------------------------
Starting WS Elev    =   837.25 ft
Starting Volume     =     .000 ac-ft
Starting Outflow    =      .00 cfs
Starting Infiltr.   =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment      =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow      =      4.27 cfs    at   11.9000 hrs
Peak Outflow     =      2.49 cfs    at   12.0500 hrs
-----------------------------------------------------
Peak Elevation   =   838.66 ft
Peak Storage =          .052 ac-ft
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =        .236
- Infiltration =        .000
- HYG Vol OUT  =        .235
- Retained Vol =        .001
                  ----------
  Unrouted Vol =       -.000 ac-ft  (.012% of Inflow Volume)
```

```
                    LEVEL POOL ROUTING SUMMARY

 HYG Dir           = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
 Inflow  HYG file = NONE STORED - CAP SW BASIN IN  10
 Outflow HYG file = NONE STORED - CAP SW BASIN OUT 10

 Pond Node   Data = CAP SW BASIN
 Pond Volume Data = CAP SW BASIN
 Pond Outlet Data = stormwater swale

 No Infiltration

 INITIAL CONDITIONS
 ----------------------------------
 Starting WS Elev   =   837.25 ft
 Starting Volume    =     .000 ac-ft
 Starting Outflow   =      .00 cfs
 Starting Infiltr.  =      .00 cfs
 Starting Total Qout=      .00 cfs
 Time Increment     =    .0500 hrs


 INFLOW/OUTFLOW HYDROGRAPH SUMMARY
 =====================================================
 Peak Inflow      =      5.13 cfs    at   11.9000 hrs
 Peak Outflow     =      2.85 cfs    at   12.0500 hrs
 -----------------------------------------------------
 Peak Elevation   =   838.79 ft
 Peak Storage =          .063 ac-ft
 =====================================================


 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol   =       .000
+ HYG Vol IN    =       .284
- Infiltration =       .000
- HYG Vol OUT   =       .283
- Retained Vol =       .001
                 ----------
 Unrouted Vol =      -.000 ac-ft  (.010% of Inflow Volume)
```

LEVEL POOL ROUTING SUMMARY

```
HYG Dir           = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
Inflow  HYG file = NONE STORED - CAP SW BASIN IN  25
Outflow HYG file = NONE STORED - CAP SW BASIN OUT 25

Pond Node   Data = CAP SW BASIN
Pond Volume Data = CAP SW BASIN
Pond Outlet Data = stormwater swale

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev    =   837.25 ft
Starting Volume     =     .000 ac-ft
Starting Outflow    =      .00 cfs
Starting Infiltr.   =      .00 cfs
Starting Total Qout=       .00 cfs
Time Increment      =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow      =       6.44 cfs    at   11.9000 hrs
Peak Outflow     =       3.27 cfs    at   12.0500 hrs
-----------------------------------------------------
Peak Elevation   =     838.99 ft
Peak Storage =           .083 ac-ft
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =        .357
- Infiltration =         .000
- HYG Vol OUT   =        .356
- Retained Vol =         .001
                   ----------
  Unrouted Vol =       -.000 ac-ft  (.008% of Inflow Volume)
```

```
                    LEVEL POOL ROUTING SUMMARY

 HYG Dir           = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
 Inflow  HYG file = NONE STORED - CAP SW BASIN IN  50
 Outflow HYG file = NONE STORED - CAP SW BASIN OUT 50

 Pond Node   Data = CAP SW BASIN
 Pond Volume Data = CAP SW BASIN
 Pond Outlet Data = stormwater swale

 No Infiltration

 INITIAL CONDITIONS
 ----------------------------------
 Starting WS Elev    =    837.25 ft
 Starting Volume     =      .000 ac-ft
 Starting Outflow    =       .00 cfs
 Starting Infiltr.   =       .00 cfs
 Starting Total Qout=        .00 cfs
 Time Increment      =     .0500 hrs


 INFLOW/OUTFLOW HYDROGRAPH SUMMARY
 =====================================================
 Peak Inflow        =       7.31 cfs     at    11.9000 hrs
 Peak Outflow       =       3.47 cfs     at    12.0500 hrs
 -----------------------------------------------------
 Peak Elevation     =     839.10 ft
 Peak Storage =             .097 ac-ft
 =====================================================


 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol   =         .000
+ HYG Vol IN    =         .407
- Infiltration =          .000
- HYG Vol OUT   =         .406
- Retained Vol =          .001
                    ----------
  Unrouted Vol =        -.000 ac-ft   (.007% of Inflow Volume)
```

LEVEL POOL ROUTING SUMMARY

```
HYG Dir            = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
Inflow  HYG file = NONE STORED - CAP SW BASIN IN  100
Outflow HYG file = NONE STORED - CAP SW BASIN OUT 100

Pond Node   Data = CAP SW BASIN
Pond Volume Data = CAP SW BASIN
Pond Outlet Data = stormwater swale

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev   =   837.25 ft
Starting Volume    =     .000 ac-ft
Starting Outflow   =      .00 cfs
Starting Infiltr.  =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment     =    .0500 hrs

INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow      =       8.63 cfs    at   11.9000 hrs
Peak Outflow     =       3.75 cfs    at   12.0500 hrs
-----------------------------------------------------
Peak Elevation   =     839.28 ft
Peak Storage =            .120 ac-ft
=====================================================

MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =        .483
- Infiltration =         .000
- HYG Vol OUT   =        .482
- Retained Vol =         .001
                   ----------
Unrouted Vol =        -.000 ac-ft  (.006% of Inflow Volume)
```

LEVEL POOL ROUTING SUMMARY

```
HYG Dir           = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
Inflow  HYG file = NONE STORED - SITE SW BASININ 2
Outflow HYG file = NONE STORED - SITE SW BASINOUT 2

Pond Node   Data = SITE SW BASIN
Pond Volume Data = SITE SW BASIN
Pond Outlet Data = stormwater basin

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev    =   837.25 ft
Starting Volume     =     .000 ac-ft
Starting Outflow    =      .00 cfs
Starting Infiltr.   =      .00 cfs
Starting Total Qout=       .00 cfs
Time Increment      =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow       =     24.90 cfs    at    11.9000 hrs
Peak Outflow      =      3.28 cfs    at    12.2500 hrs
-----------------------------------------------------
Peak Elevation    =    838.50 ft
Peak Storage =             .594 ac-ft
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =       1.376
- Infiltration  =        .000
- HYG Vol OUT   =       1.376
- Retained Vol  =        .000
                   ----------
  Unrouted Vol  =       -.000 ac-ft   (.008% of Inflow Volume)
```

LEVEL POOL ROUTING SUMMARY

```
HYG Dir           = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
Inflow  HYG file = NONE STORED - SITE SW BASININ  5
Outflow HYG file = NONE STORED - SITE SW BASINOUT 5

Pond Node   Data = SITE SW BASIN
Pond Volume Data = SITE SW BASIN
Pond Outlet Data = stormwater basin

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev   =   837.25 ft
Starting Volume    =     .000 ac-ft
Starting Outflow   =      .00 cfs
Starting Infiltr.  =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment     =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow      =    37.31 cfs    at   11.9000 hrs
Peak Outflow     =     4.08 cfs    at   12.3500 hrs
-----------------------------------------------------
Peak Elevation   =   838.92 ft
Peak Storage =          .946 ac-ft
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =       2.087
- Infiltration  =        .000
- HYG Vol OUT   =       2.087
- Retained Vol  =        .000
                   ----------
Unrouted Vol =         -.000 ac-ft  (.005% of Inflow Volume)
```

```
                    LEVEL POOL ROUTING SUMMARY

  HYG Dir           = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
  Inflow  HYG file = NONE STORED - SITE SW BASININ  10
  Outflow HYG file = NONE STORED - SITE SW BASINOUT 10

  Pond Node   Data = SITE SW BASIN
  Pond Volume Data = SITE SW BASIN
  Pond Outlet Data = stormwater basin

  No Infiltration

  INITIAL CONDITIONS
  ----------------------------------
  Starting WS Elev   =    837.25 ft
  Starting Volume    =      .000 ac-ft
  Starting Outflow   =       .00 cfs
  Starting Infiltr.  =       .00 cfs
  Starting Total Qout=       .00 cfs
  Time Increment     =     .0500 hrs

  INFLOW/OUTFLOW HYDROGRAPH SUMMARY
  =====================================================
  Peak Inflow       =      43.51 cfs    at   11.9000 hrs
  Peak Outflow      =       4.43 cfs    at   12.3500 hrs
  -----------------------------------------------------
  Peak Elevation    =    839.13 ft
  Peak Storage =          1.132 ac-ft
  =====================================================

  MASS BALANCE (ac-ft)
  -------------------------
+ Initial Vol   =         .000
+ HYG Vol IN    =        2.450
- Infiltration  =         .000
- HYG Vol OUT   =        2.450
- Retained Vol  =         .000
                    ----------
  Unrouted Vol  =        -.000 ac-ft  (.004% of Inflow Volume)
```

LEVEL POOL ROUTING SUMMARY

```
HYG Dir           = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
Inflow  HYG file = NONE STORED - SITE SW BASININ  25
Outflow HYG file = NONE STORED - SITE SW BASINOUT 25

Pond Node   Data = SITE SW BASIN
Pond Volume Data = SITE SW BASIN
Pond Outlet Data = stormwater basin

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev    =   837.25 ft
Starting Volume     =     .000 ac-ft
Starting Outflow    =      .00 cfs
Starting Infiltr.   =      .00 cfs
Starting Total Qout=       .00 cfs
Time Increment      =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow      =     52.78 cfs    at   11.9000 hrs
Peak Outflow     =      7.08 cfs    at   12.2500 hrs
-----------------------------------------------------
Peak Elevation   =    839.38 ft
Peak Storage =         1.367 ac-ft
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =       3.000
- Infiltration =        .000
- HYG Vol OUT  =       3.000
- Retained Vol =        .000
                  ----------
  Unrouted Vol =       -.000 ac-ft  (.004% of Inflow Volume)
```

```
                  LEVEL POOL ROUTING SUMMARY

 HYG Dir           = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
 Inflow  HYG file = NONE STORED - SITE SW BASININ  50
 Outflow HYG file = NONE STORED - SITE SW BASINOUT 50

 Pond Node   Data = SITE SW BASIN
 Pond Volume Data = SITE SW BASIN
 Pond Outlet Data = stormwater basin

 No Infiltration

 INITIAL CONDITIONS
 ----------------------------------
 Starting WS Elev    =   837.25 ft
 Starting Volume     =     .000 ac-ft
 Starting Outflow    =      .00 cfs
 Starting Infiltr.   =      .00 cfs
 Starting Total Qout=       .00 cfs
 Time Increment      =    .0500 hrs


 INFLOW/OUTFLOW HYDROGRAPH SUMMARY
 =====================================================
 Peak Inflow       =     58.93 cfs    at   11.9000 hrs
 Peak Outflow      =      9.68 cfs    at   12.1500 hrs
 -----------------------------------------------------
 Peak Elevation    =   839.54 ft
 Peak Storage =          1.512 ac-ft
 =====================================================


 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol    =       .000
+ HYG Vol IN     =      3.369
- Infiltration   =       .000
- HYG Vol OUT    =      3.369
- Retained Vol   =       .000
                    ----------
  Unrouted Vol   =      -.000 ac-ft  (.003% of Inflow Volume)
```

LEVEL POOL ROUTING SUMMARY

```
HYG Dir           = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
Inflow  HYG file  = NONE STORED - SITE SW BASININ  100
Outflow HYG file  = NONE STORED - SITE SW BASINOUT 100

Pond Node   Data  = SITE SW BASIN
Pond Volume Data  = SITE SW BASIN
Pond Outlet Data  = stormwater basin

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev    =    837.25 ft
Starting Volume     =      .000 ac-ft
Starting Outflow    =       .00 cfs
Starting Infiltr.   =       .00 cfs
Starting Total Qout=        .00 cfs
Time Increment      =     .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow      =     68.12 cfs    at    11.9000 hrs
Peak Outflow     =     12.32 cfs    at    12.1500 hrs
-----------------------------------------------------
Peak Elevation   =    839.78 ft
Peak Storage =         1.742 ac-ft
=====================================================


MASS BALANCE (ac-ft)
------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =       3.926
- Infiltration  =        .000
- HYG Vol OUT   =       3.925
- Retained Vol  =        .000
                  -----------
  Unrouted Vol =        -.000 ac-ft  (.003% of Inflow Volume)
```

Index of Starting Page Numbers for ID Names

STORM SEWEP MPUTATION SHEET

BASED RMULA Q=CiA

SHEET 1 OF 1

MUNICIPALITY: ____________________ SUBDIVISION OR LOCALITY: ____________________

COMPUTED BY: D. Stewart DATE: 1-Oct-10 CHECKED BY: P. Stratman DATE: 4-Oct-10

REVISED BY: ____________ DATE: ____________ "N" VALUE: 0.024 PIPE MATERIAL: CPE

WHEN PIPE SIZE CHANGES: ◉ MATCH CROWNS ○ MATCH 0.8xDIAMETER

DESIGN STORM: 100 YR. DROP ACROSS STRUCTURE WITH NO PIPE SIZE CHANGE: 0 FEET

FROM	TO	INCREMENTAL AREA (AC)	COEFFICIENT OF RUNOFF (C)	EQUIVALENT AREA (AC x C)	TOTAL EQUIVALENT AREA	TIME OF CONCENTRATION (MIN)	INTENSITY (I) (INCHES / HOUR)	Q (CFS)	PIPE SLOPE (FT PER FT)	PIPE DIAMETER (IN)	VELOCITY (FPS)	PIPE LENGTH (FT)	TIME OF FLOW (MIN)	PIPE CAPACITY (CFS)	GROUND ELEVATION UPPER END	GROUND ELEVATION LOWER END	INVERT ELEVATION UPPER END	INVERT ELEVATION LOWER END
O. Struc.	Outfall							16.1	0.010	30	4.5	25	0.1	22.2			837.15	836.90

The flow of 16.1 CFS is the combination of flow entering the outlet structure from both Stormwater Basins.

ADVANCED GeoServices

Engineering for the Environment. Planning for People.™

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CAP STABILITY CALCULATIONS

CAP STABILITY CALCULATIONS

Advanced GeoServices

Engineering for the Environment. Planning for the People

Purpose: To calculate the Factor of Safety against sliding for critical interfaces within the geosynthetic liner system.

Known Information:

Sketch:

Cover soil

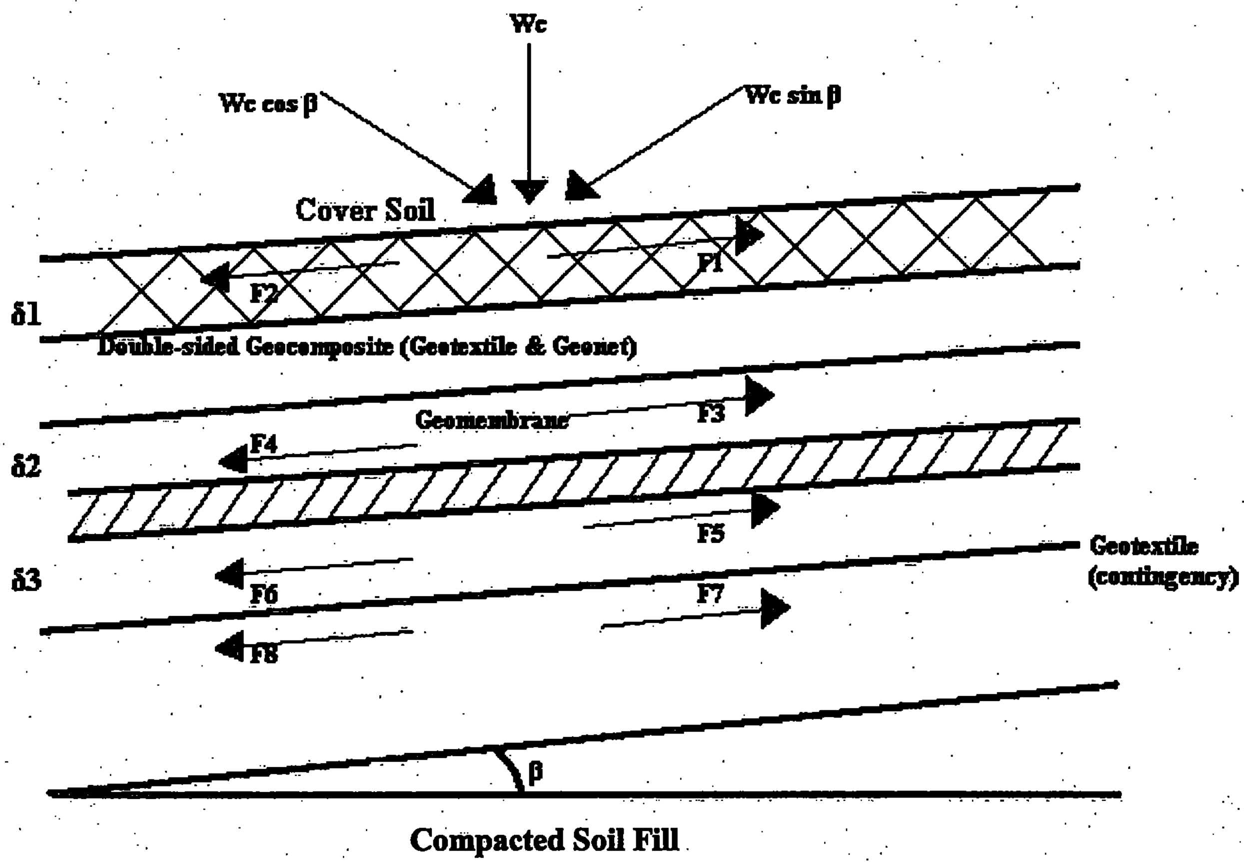
Double-sided geocomposite (nonwoven geotextile and geonet)

geomembrane

geotextile (contingency)

Compacted Soil Fill

Free Body Diagram:



Method: This analysis is performed in accordance with published methods.

Equations:

Weight of the central zone, Wc, is:

$$Wc = \frac{H}{\sin\beta}\, t \cdot \gamma$$

where H = slope height, L = slope length
β = slope angle
t = cap thickness
γ = cap material unit weight

Driving Force; Dc = Wc sin β
Resisting Force, Rc = Wc cos β tan δ_1
Where δ_1 = interface friction angle between soil and upper layer of geotextile
F_1 = Rc as long as the maximum force can be mobilized
F_3 = Wc cos β tan δ_2
Where δ_2 = interface friction angle between geotextile and geomembrane.
F_5 = Wc cos β δ_3
Where δ_3 = interface friction angle between geomembrane and geotextile (contingency).
F_7 = Wc cos β tan δ_4
Where δ_4 = interface friction angle between geotextile and the soil sub-base.
By equilibrium, F1 = F2; F3 = F4; F5 = F6; and F7 = F8.

Factor of Safety $FS = \dfrac{Rc}{Dc}$

Assumptions:

- The contribution of passive and active forces are ignored.
- The critical interface is geocomposite to geomembrane (δ_2).
- The geonet / geocomposite provides adequate drainage.
- The cover soil is SM – SC, silt-sand clay mix.
- L = 48' at 3H:1V, H = 16' (This is a conservative scenario)
  β = 18.3°
  T = 2.0'
  γ = 120 pcf
  ϕ = 30°
  δ_1 = 25° - cover soil vs. upper layer of geotextile (range 20° - 28°)
  δ_2 = 22° - smooth 60 mil geomembrane vs. double sided geocomposite.
  δ_3 = 22° - smooth 60 mil geomembrane vs. geotextile
  δ_4 = 25° - geotextile vs. soil sub-base (range 20° - 28°)
- The acceptable factor of safety = 1.2
- The maximum force can be mobilized

Source of Numerical Values:
- Slope of geometry was determined from the design drawings.
- Cover soil characteristics were taken from NAVFAC DM 7.01, 1986.
- Interface friction angles assumed, but must be confirmed with laboratory testing.

Calculations:

Based on review of the interface friction angles, the critical interface (i.e. lowest friction angle) is geocomposite (geotextile) vs. smooth geomembrane

Weight of central zone:

$$Wc = \frac{H}{\sin \beta}\, t \cdot \gamma$$

$$Wc = \frac{16'}{\sin 18.3°}(2.0')(120 pcf)$$

Wc = 12,230 lb/ft width

Driving Force

Dc = Wc sin β = [(12,230 lb/ft width)(sin18.3°)]

Dc = 3,840 lb/ft width

Resisting Force at critical interface, Rc

$F_3 = F_4$ (by equilibrium)

$Rc = F_3 = Wc \cos \beta \tan \delta_2$

Rc = 12,230 cos 18.3° tan 22°

Rc = 4,691 lb/ft width

If all Rc is mobilized, $Fs = \frac{Rc}{Dc}$

$$Fs = \frac{4{,}691 lb / ftwidth}{3{,}840 lb / ftwidth} = 1.22$$

1.22 > 1.2 and therefore is acceptable

Determine factor of safety for δ_1.

Cover soil vs. Geocomposite (Double sided geotextile with geonet)

As shown previously, Dc = 3,840 lb/ft width

Wc = 12,230 lb/ft width

$Rc = F_1 = F_2 = Wc \cos \beta \tan \delta_1$

Rc = 12,230 lb/ft width cos 18.3° tan 25°

Rc = 5,415 lb/ft width

$$FS = \frac{Rc}{Dc} = \frac{5{,}415 lb / ftwidth}{3{,}840 lb / ftwidth} = 1.41$$

1.41 > 1.2 and therefore acceptable

Determine minimum interface friction angle

$$FS = 1.2 = \frac{Rc}{3{,}840 lb / ftwidth}$$

Rc = 1.2 (3,840 lb/ft width) = 4,608 lb/ft width

Rc = Wc cos β tan δ

$$\delta = \tan^{-1}\left(\frac{4{,}608 lb / ftwidth}{12{,}230 lb / ftwidth(\cos 18.3°)}\right)$$

δ = 21.65° => use 22°

Conclusions:

Interface friction testing must show results >22° for each interface when finished slope = 33%. The friction forces are sufficient to resist sliding without transferring strain to the geomembrane.

ATTACHMENT D

Construction Quality Assurance Plan

ATTACHMENT D

Construction Quality Assurance Plan

CONSTRUCTION QUALITY ASSURANCE PLAN
CORRECTIVE MEASURES IMPLEMENTATION
REFINED METALS CORPORATION
BEECH GROVE, INDIANA

Prepared For:

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1.0 OBJECTIVE

Quality Assurance is defined as a planned and systematic pattern of means and actions designed to provide adequate confidence that items or services meet contractual and regulatory requirements and will perform satisfactorily in service. Quality Control is defined as those actions which provide a means to measure and regulate the characteristics of an item or service in accordance with contractual and regulatory requirements.

This Construction Quality Assurance Plan (CQAP) establishes the quality assurances procedures for implementation of the Corrective Measures (CM) Design at the former Refined Metals Corporation (RMC) facility in Beech Grove Indiana. The purpose of the CQAP is to ensure that the quality control objectives spelled out in the specifications are being met and that RMC receives a quality project that will serve its intended purpose with minimal maintenance. The activities involving quality assurance activities identified in this CQAP include the following:

- Erosion and sediment control
- Transportation of waste materials
- Dust control
- Demolition of remnant structures
- Surveying
- Soil and sediment remediation
- Earthwork
- Containment cell capping
- Restoration

2.0 RESPONSIBILITIES

Owner: Refined Metals Corporation Beech Grove (RMC).

Engineer: Advanced GeoServices Corp

Contractor: The party responsible for overall implementation of the CM Design including, but not limited to, site preparation, remediation, demolition, material handling and management, earthwork, earthwork, dust control and air sampling, water management, containment cell construction and capping, and site restoration. While portions of the work associated with implementation of the CM Design may be subcontracted by the Contractor, the Contractor is ultimately responsible for overall quality of the completed project and completion within the agreed upon schedule and budgetary amounts.

Manufacturer: The party responsible for the production and/or supplying of products and materials purchased from off-site vendors. This shall include, but not be limited to, everything from temporary controls, such as silt fence, to imported soil, aggregate and topsoil, to geosynthetic components within the containment cell cap. The Contractor is ultimately responsible for ensuring that the materials and products utilized for the project meet the requirements of the specifications and are installed in accordance with the requirements and intent of the CM Design, including this CQAP. If the Contractor wishes to propose an alternate product or material in lieu of a specified material or because the material is no longer available or inappropriate for actual field conditions, the Contractor shall notify the QA Representative and seek approval prior to delivery of such materials or products to the site.

Installer: The party responsible for field handling, transportation, storing, deploying, seaming, temporary restraining (against wind), and installation of the geosynthetic components of the containment cell cap. (In some cases, the Manufacturer and Installer or Contractor and Installer could be the same party). The Installer shall be retained by the Contractor as a subcontractor.

Quality Assurance (QA) Representative: The party retained by RMC and independent from the Contractor or any of the Contractor's subcontractors that is responsible for observing and documenting activities related to the quality assurance of the work and compliance with the requirements of the CM Design. The QA Representative will be on-site on a full-time basis and will maintain open lines of communication between the Contractor, RMC, the CM Design Engineer, regulatory representatives.

Quality Assurance Analytical Testing Laboratory: The party retained by QA Representative for the purpose of analyzing confirmatory samples and supplemental sampling of borrow source materials, crushed concrete or other analysis as deemed appropriate during the work.

Contractor's Analytical Testing Laboratory: The party retained by Contractor for the purpose of analyzing borrows source materials, air samples, crushed concrete or other analysis as deemed appropriate during the work. The QA Analytical Testing Laboratory and the Contractor's Analytical Testing Laboratory shall not be the same lab.

Geosynthetic Testing Laboratory: The party, independent from the Contractor, Manufacturer, and Installer, responsible for conducting tests on samples of the geomembrane field seams obtained at the site. Laboratory to be retained by Contractor or Installer and approved by RMC.

3.0 QUALIFICATIONS

General

Presented in this section are the minimum qualification requirements for the key organizations involved with the implementation of the CM Design. The minimum standards must be demonstrated for each of the major categories listed. Where the specific services will be performed by a subcontractor, the primary contractor must provide documentation of appropriate experience for all subcontractors proposed for the project. All personnel performing intrusive activities or working in areas of exposed contaminants shall have a minimum of 40-hours of safety training with a current 8-hour annual refresher in accordance with 29 CFR 1910.120.

QA Representative

The QA Representative shall be experienced in construction and remediation projects, shall possess strong written and verbal skills and have experience in material placement and compaction, earthwork activities, geosynthetic installation, environmental sampling and understand basic surveying techniques.

Contractor

The Contractor shall have experience in constructing projects of similar size and scope and shall have completed at least six projects involving the remediation of soil and sediment impacted by inorganic contaminants. All employees of the Contractor shall have a minimum of 40- hours of safety training with current 8-hour annual refresher in accordance with 29 CFR 1910.120, and required site training.

Installer

The Installer shall be licensed or approved to install the Manufacturer's geomembrane. The Installation Supervisor shall have installed or supervised the installation of a minimum of 5,000,000 square feet of High Density Polyethylene (HDPE) liner. The Master Seamer shall have installed a minimum of 5,000,000 square feet of HDPE experience. All other seamers shall have installed a minimum of 500,000 square feet of geomembrane. All employees of the Installer shall have a minimum of 40-hours of safety training with current 8-hour annual refresher in accordance with 29 CFR 1910.120.

4.0 INSPECTION ACTIVITIES

Erosion and Sediment Control

Prior to construction, the Contractor is required to submit manufacturer's information for silt fence, construction entrances, contaminant reduction zones and related erosion and sediment control materials as described in Specification Section 02115. The QA representative shall review the Contractor's submittals for compliance with the requirements of the Specifications and CM design.

The erosion and sediment controls provide protection against the transport of potentially contaminated sediment from the active remediation area and protection against the transport sediment from those areas not designated for remediation and those areas where remediation has been completed. During execution, the QA Representative shall ensure that erosion and sediment controls are installed as required to prevent the migration of sediment laden water (contaminated or uncontaminated) and that water from areas designated for remediation do not cross-contaminate clean areas. The review will evaluate actual site conditions against the requirements for erosion and sediment control measure as depicted on Sheet 4 of the design drawings and may adjust the proposed location, amount and type of control to fit actual conditions. The review will be conducted in cooperation with the Contractor and with input from the CM Engineer as appropriate.

As work progresses site conditions will likely change and the integrity of the silt fence may degrade because of siltation, damage or general disturbance. The QA Representative will evaluate the adequacy of installed erosion and sediment measures at a minimum on a weekly basis, after each runoff producing precipitation event and when the active work zone progresses. The QA representative shall ensure that the Contractor removes accumulated sediment from erosion and sediment control measures protecting active remediation areas prior to approving restoration of the remediation areas.

Transportation of Waste Materials

Truck loading will be monitored to help prevent trucks from being overloaded, although ultimately it will be the drivers and Contractor's responsibility to be certain trucks are not overloaded. Prior to leaving the loading area the bed of each hauling unit will be covered with a closely woven net tarp or canvass tarp to prevent the escape of windblown soil during transportation to the disposal facility. Each truck will be decontaminated in the Contamination Reduction Zone (CRZ) as required to prevent the off-site migration of contaminated materials. The loading area will be maintained in a clean manner, spilled material will be cleaned up as necessary. The designated truck route to the selected disposal facility will be presented to each truck driver prior to leaving the site.

Each load of waste material destined for off-site disposal (demolition debris not approved for placement in the Containment Cell) will be transported under a properly executed Bill of Lading or Hazardous Waste Manifest, as appropriate and as required by Specification Section 01355. Each bill of lading or manifest will be numbered sequentially to allow the number of loads hauled from the site to be tracked.

The QA Representative will be responsible ensuring that RMC has approved the proposed disposal or recycling destination and waste profiles have been signed by RMC and approved by the destination facility. The QA representative shall record in his fieldbook when shipments are sent off-site, the classification of the waste (hazardous versus non-hazardous), and the destination facility. The QA representative shall track that proof of disposal and disposal weight for each shipment has been received from the Contractor.

Dust Control and Air Monitoring

It is the intent of RMC to have the Contractor perform proposed CM construction activities in a manner capable of achieving the National Ambient Air Quality Standards (NAAQS) for lead. Specification Section 02999 provides the dust control and air monitoring requirements. As shown, the Contractor is responsible for providing real-time and time-integrated air sampling. The QA Representative shall review Contractor submittals for proposed sampling equipment, analytical laboratory, sampling station/platform configuration, and qualification of Contractor personnel. The locations for the proposed time-integrated samplers (TSP and total lead samplers) shall be situated as shown on Sheet 4 of the design drawings and may only be changed with consensus approval of RMC, USEPA, IDEM and CM Engineer.

The Contractor will be required to provide real-time monitoring around the perimeter of the active remediation zone. The QA representative will calculate an allowable Trigger Level for the real-time active work zones utilizing the average lead concentration for the area being remediated and a target maximum lead in air concentration of 0.15 mg/m3.

An example calculation would be as follows:

Average lead concentration of soil being remediated = 2,000 mg/kg = 0.002 mg/mg
Target Maximum lead in air concentration = 0.15 mg/m3

Trigger Level = (0.15 mg/m3)/0.002 mg/mg = 75 mg/m3

The Trigger Level represents a conservative value to utilize as a real-time measure for dust control. During execution it is possible that the Contractor may not be able to meet the calculated value when working in a very high concentration area. When an exceedance occurs; the Contractor shall temporarily stop work, review site conditions with the QA Representative, identify alternate/additional measures and implement the agreed upon measures before continuing work. If the area continues to exceed the Trigger Level the determination to allow continued work will be made based by the QA Representative in consultation with RMC. Short-term periods when a Trigger Level is exceeded will not be considered a failure of the dust control standards, but regular or protracted exceedances will not be permitted.

During execution of the work, the QA representative will review periodically throughout each work day the location and level of protection being provided by the Contractor. The QA Representative will obtain information regarding the wind direction and wind speed periodically during the day and record the information in the fieldbook. In addition, the Contractor is required to submit daily records with the Daily Report. The QA representative will consider wind speed and direction when evaluating the adequacy of dust control measures. Under high wind or extreme dry conditions it may be necessary for the Contractor to suspend work.

The QA Representative shall ensure that the methods and means being utilized for dust control are adequate for the site conditions and activities. The QA Representative shall have the authority to stop the work if he/she believes that the dust control procedures being utilized are inadequate. Adequacy of dust controls will be determind based on visual observations, real-time air monitoring, and laboratory TSP and lead results for the high volume air monitors.

<u>Demolition of Remnant Structures</u>

The QA representative shall review the Contractor's schedule, techniques and proposed limits for the required demolition and confirm that the work is coordinated with other work activities, that the techniques are appropriate for the nature of the demolition and the limits are consistent with the CM Design.

Surveying

The QA Representative shall review the approach to surveying proposed by the Contractor's Surveyor for technical approach and consistency with the CM Design. Specific attention will be given to the proposed grid system and cross-sections and establishment of bench marks. The elevation of each grid shall be surveyed prior to excavation or demolition and the system utilized must be reproducible to allow the documentation of removal depths relative to starting elevations and the adequacy of restoration. This data will be compared with the site characterization previously performed to insure that the depth of excavation is adequate. The Contractor is permitted to monitor removal depths using his own equipment provided that the monitoring is tied to within 1.0 feet of the originally established grid and cross-sections and accurate to within 0.1 feet vertically.

Soil and Sediment Remediation

The Surveyor will stakeout the horizontal limits of the removal areas, and the QA Representative and Contractor shall review the staked limits for consistency with the design and actual field conditions. Discrepancies or concerns should be raised with the Engineer prior to the start of excavation in the subject area. The QA Representative shall review the Contractor's protocol and controls for establishing removal limits.

The QA Representative shall confirm that affected soil and sediments are placed in the Containment Cell in accordance with following performance criteria indentified in the CM Design.

The QA Representative shall confirm that:

- Property Owner approvals have been received.
- Water management features have been established prior to the start of removal.

- The limits of initial excavation have been clearly marked and the existing elevations have been documented prior to the start of work.
- Excavations are conducted using methods approved by the QA Representative which prevent transport of sediments and minimize generation of water.
- Excavation sequencing is conducted as proposed by the Contractor and approved by QA Representative and RMC.
- Excavations have extended only to the limits marked, unless analytical data collected by the QA Representative confirms that additional excavation is necessary.
- The Contractor is employing measures to prevent contamination of soils not indicated for excavation.
- The excavation depth has extended to the depths identified in the CM Design (+/- 3-inches) or as directed by the QA Representative based on the previous sampling results.
- Confirmatory sampling has been conducted by the QA Representative.
- All visible waste materials (slag and battery casings) have been removed to the satisfaction of the QA Representative.
- Measures are employed to minimize the amount of water generated during construction. Water removed from within the excavation is contained and treated.
- Excavations are conducted to obtain the performance standards identified in the CM Design.
- Excavated materials are transported directly to the containment cell for placement.
- Materials being placed in the containment cell are placed in 12 inch loose lifts and are being compacted in a manner to create a stable surface capable of supporting the final cap.
- Material is placed in the containment cell using the sequencing proposed by the Contractor and approved by the QA Representative.
- The maximum material size is 12 inches in the longest direction.

- The top 6 inches of material are remediated soils with a maximum particle size of 2-inches.
- Cleared and grubbed materials not shipped off-site or approved for use elsewhere on-site is ground (<3 inches in longest dimension) and placed in a single 4 inch thick maximum lift.

Sampling and Analysis

The QA Representative will ensure that the confirmatory sampling discussed in the CM Design and the SAP included as part of this CQAP are followed.

Earthwork

Imported topsoil and/or fill shall be tested for compliance with the specifications prior to delivery to the site. Topsoil placement shall be monitored to ensure that it has been graded to promote drainage and prevent ponding and that it has been placed to the elevations specified. Topsoil materials whether placed for turf establishment or placed to sustain sod shall be fertilized and amended as recommended based on the agronomy testing required by the Specifications.

The QA Representative shall monitor the placement and compaction of on-site fill materials to insure that it is being placed and adequately compacted to prevent future settlement and promote positive drainage. The QA representative shall receive and review copies of the geotechnical laboratory and field density testing performed by the Contractor's QC representative.

Containment Cell Capping

The QA Representative shall review and discuss the Contractors proposed approach (construction sequence and construction techniques) for capping the containment cell. To the extent possible, installation of the geomembrane shall be completed as soon as possible after the final tops of waste elevations are achieved. If the time between achieving final grades and geomembrane installation will be greater than one week, the Contractor shall be required to protect the completed surface using temporary plastic sheeting placed in such a manner to shed precipitation and prevent direct contact of precipitation with the contaminated soils.

The 18-inch thick cover soil layer shall be placed as a single lift and construction equipment (except small rubber tired ATVs utilized by the Installer during geosynthetic deployment) will not be permitted on to the areas of the completed geomembrane installation until the cover soil layer is in-place. QA Representative shall ensure that all required inspections and documentation of the liner installation activities is completed prior to soil placement.

Topsoil will be submitted to a soils laboratory for analysis to insure that the topsoil is amended with the proper amount of fertilizer and agricultural lime. Seed and fertilizer shall be selected and applied as recommended by the local USDA Soil Conservation Office. Seed variety will be selected based upon the time of year the planting is to be completed and to insure a viable stand of grass is established that will require a minimum amount of maintenance. Seed shall be state-certified seed of the latest season's crop.

5.0 SAMPLING REQUIREMENTS

The QA Representative shall report the analytical results for post-excavation sampling, with appropriate sample identification and location, to RMC and Contractor within 24 hours of receiving the results from the laboratory.

The QA Representative in consultation with RMC and the Contractor, will determine the limits and extent of further excavation based upon the results of the sample analysis. RMC and its representatives may request additional samples for analysis to assist in the determination. Excavation and confirmatory sampling will continue until the performance criteria have been met.

The QA Representative shall ensure that:

- Sampling is conducted at the frequency indicated in the Specifications.
- Post-excavation samples within HWMUs are analyzed for total lead, arsenic, antimony, cadmium and selenium. Post-excavation samples outside of HWMUs are analyzed for total lead.
- Performance standards are as indicated in the Specifications.

6.0 DOCUMENTATION

An effective CQAP depends largely on recognition of all construction activities that should be monitored, and on assigning responsibilities for the monitoring of each activity. This is most effectively accomplished and verified by the documentation of Quality Assurance activities. The QA Representative will document that the Quality Assurance requirements have been addressed and satisfied.

Following review, the QA Representative will provide the RMC with signed descriptive remarks, data sheets, and logs to verify that the monitoring activities have been carried out in accordance with the CQAP and that performance standards established in the CM Design Report have been achieved. The Contractor will maintain at the Site a complete file of the CM Design Report, Drawings and Specifications, CQAP, checklists, test procedures, daily logs, and other pertinent documents.

Daily Recordkeeping

The QA Representative's standard reporting procedures will include preparation of a weekly CQA report which, at a minimum, will consist of:

- a discussion of Site activities, including CQC testing, performed during the week;
- CQA and regulatory personnel and visitors present at the Site;
- field notes, including memoranda of meetings and/or discussions with participating parties or regulatory authorities;
- CQA monitoring logs and testing data sheets;
- construction problem and solution summary sheets;
- submittal status;
- date and weather conditions; and,

- signature of the QA Representative.

This information will be regularly submitted to and reviewed by RMC.

Monitoring Logs and Test Data Sheets

CQC monitoring logs and test data sheets will be prepared daily by the Contractor. When QA testing is performed, related monitoring logs and test data sheets shall be completed by the QA Representative for that work. At a minimum, these logs and data sheets will include the following information:

- an identifying sheet number for cross referencing and document control;
- date, project name, location, and other identification;
- data on weather conditions;
- descriptions and locations of ongoing construction;
- equipment and personnel in each work area, including subcontractors;
- descriptions and specific locations of areas, or units, of work being tested and/or observed and documented;
- locations where tests and samples were taken;
- a summary of test results;
- calibrations or recalibrations of test equipment, and actions taken as a result of recalibration;
- delivery schedule of off-site materials received, including Quality Control documentation;
- decisions made regarding acceptance of units of work, and/or removal activities to be taken in instances of substandard quality; and,
- signature.

RMC will be made aware of any significant recurring non-conformance with the Specifications. The Engineer will review the issues with the QA Representative to determine the cause of the non-conformance and recommend appropriate changes in procedures or Specifications. These changes will be submitted to the IDEM and the USEPA, as appropriate.

A summary of the supporting data sheets, along with final testing results and the QA Representative's approval of the work, will be required upon completion of construction.

Photographic Documentation

Photographs will be taken by the Contractor in order to serve as a pictorial record of work progress, problems, and removal activities. The basic file will contain color prints, labeled with the date, and subject of the photograph. These records will be presented to RMC upon completion of the project. Photographic reporting data sheets, where used, will be cross-referenced with observation and testing data sheet(s), and/or construction problem and solution data sheet(s). The Contractor will allow the RMC representatives to examine photographs at the Site, upon request.

Corrective Measures Design Plan and/or Specification Changes

The CMD and/or Specifications changes may be required during construction. In such cases, the Contractor will notify RMC and QA Representative when a change is believed to be warranted. Changes will be made only with the written agreement of the Engineer (following review and consultation with QA Representative, IDEM and USEPA, if necessary), and will take the form of an addendum to the Specifications.

Signatures and Final Report

At the completion of the work, the QA Representative will submit to RMC signed and sealed Final Reports. These reports will include an appropriate certification statement and will certify: (i) that the work has been performed in compliance with the CMD; (ii) physical sampling and testing, except as properly authorized, have been conducted at the appropriate frequencies; and (iii) that the summary document provides the necessary supporting information.

At a minimum, this report will include: (i) summaries of all construction activities; (ii) testing data sheets including sample location plans; (iii) construction problems and solutions data sheets; (iv) changes from design and Specifications; (v) record (as-built) drawings (to be provided by the Contractor); and (vi) a summary statement sealed and signed by a Professional Engineer registered in the State of Indiana.

The as-built drawings provided by the Contractor will include scale drawings depicting the location of the construction and details pertaining to the extent of construction (e.g. depths, plan dimensions, elevations, etc.). All surveying and base maps required for development of the record drawings will be prepared by the Contractor's qualified licensed land surveyor.

The documentation and information to be collected by the QA Representative from the Contractor for use in development of the Final Report shall include the following:

- Surveyor qualifications, including proof of Health and Safety training;
- Geomembrane Manufacturer qualifications;
- Geomembrane Installer qualifications;
- Other subcontractor qualifications;
- Contractor's Health and Safety Plan;

- Project record (as-built) drawings as required by Specification Section 01050;
- Restoration summary;
- Permits obtained by Contractor or Owner;
- Representative photographs;
- Validated soil sampling results including laboratory reports;
- If used, off-site disposal completed manifests, weight tickets, and certificates of disposal;
- Compaction test results;
- QC certificates for each roll of geosynthetic;
- Geomembrane panel layout plans;
- Installer's geomembrane certification;
- Destructive seam sample test results;
- Shear box test results;
- Quality Assurance monitoring logs and test data sheets;
- Material properties for:

  - Silt fence, and other erosion and sediment control devices;
  - CRZ and construction entrance aggregate and geotextile;
  - Water treatment system and procedures;
  - Cap geomembrane;
  - Geocomposite;
  - Aggregate and piping for cap anchor trench and outfalls;
  - Cover soil;
  - Topsoil and erosion control mat;
  - Seed, mulch and fertilizer;
  - Stormwater system piping, outlet structures and other features;
  - Fencing;

- Asphaltic Concrete Paving;
- Other site materials.

- Delivery tickets and/or certificates of compliance for all materials;
- Completed submittal register and approved submittals; and,
- Any other information needed for documentation of work in accordance with the Contract Documents.

Storage of Records

During performance of remediation activities, all records, including handwritten data sheet originals (especially those containing signatures), should be stored by the Contractor or his designee in a safe on-site repository. Other reports may be stored by a standard method which will allow for easy access.

APPENDIX A

CONFIRMATORY SAMPLING

APPENDIX A

CONFIRMATORY SAMPLING

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1.0 INTRODUCTION

1.1 GENERAL

As presented in Section 5.0 "Statement of Basis" of the Corrective Measures Design Report (Design Report), the proposed remedial activities within the horizontal limits of the former Hazardous Waste Management Units (HWMUs) shall be performed as Closure under the purview of the Indiana Department of Environmental Management (IDEM), while remediation on the remainder of the site and off-site are being performed as part of Corrective Measures under the purview of the United States Environmental Protection Agency (USEPA). Therefore, multiple remediation standards are being applied to the site. The soil standards, as discussed to greater detail in Section 5.0 of the Design Report are as follows.

1.2 CORRECTIVE MEASURES (ON-SITE AND OFF-SITE)

1.2.1 On-Site

Soil and sediment remediation on the former RMC property (outside the footprint of the HWMUs) and off-site are dictated specifically by lead. The standard for on-site for soil and sediment (outside the limits of the HWMUs) is 920 mg/kg, which corresponds to the Preliminary Remediation Goal (PRG) calculated through a site specific Baseline Human Health Risk Assessment (BHHRA) presented in and approved as part of the Corrective Measures Study (Advanced GeoServices August 6, 2007). The PRG represents the maximum allowable average concentration within a defined exposure area for the depth intervals considered in the BHHRA. For this project there are two exposure areas referred to as the "on-site exposure area" and the "grassy exposure area" (see Design Report, Figure 2) and the depth increments ("exposure depth") are 0-5 feet and 0-2.5 feet respectively.

1.2.2 Off-Site

As shown on Sheets 7 and 8, the proposed off-site excavation areas coincide with drainage ditches and swales that received surface water runoff from the facility. Sampling conducted as part of the RFI identified elevated concentrations of lead in the sediment and soil within these features. The lead remediation value for sediment and soil within these generally accessible Off-Site Areas is 400 mg/kg. The proposed soil and sediment removal is limited to the bottoms of the drainage features where concentrated surface water runoff has resulted in a lead concentrations >400 mg/kg. Within the less clearly defined drainage swale along South Arlington Avenue, the proposed excavation activities will extend from the site security fence to the edge of pavement for the road.

1.3 HAZARDOUS WASTE MANAGEMENT UNIT CLOSURE

Soil remediation within the limits of the former HWMUs is dictated by lead, as well as antimony, arsenic, cadmium and selenium. The soil remediation standards are shown below. The standards come from the IDEM RISC Industrial Closure Levels, Table A (antimony, arsenic, cadmium and selenium), while the value for lead represents the IDEM RISC Industrial Closure Levels for Construction.

Hazardous Waste Management Units (HWMUs)

Parameter	Soil Standard
Antimony	37 mg/kg
Arsenic	20 mg/kg
Cadmium	77 mg/kg
Lead	970 mg/kg
Selenium	53 mg/kg

As discussed in Section 5.0 of the Design Report, the values for lead and arsenic were justified based on site specific SPLP testing which demonstrated average partitioning coefficients more than an order of magnitude greater than the values utilized to calculate the IDEM RISC default Migration to Groundwater values.

2.0 CONFIRMATORY SAMPLING REQUIREMENTS

2.1 RMC PROPERTY (EXCLUDING HWMUs)

The removal limits shown on Sheet 7 of the design drawings have been selected to remove the highest concentration soils within each exposure area as necessary to achieve an average soil lead concentration (PRG) within the BHHRA exposure depth (0 to 5 feet within the On-Site Exposure Area and 0 to 2.5 feet within the Grassy Exposure Area) equal to or less than 920 mg/kg. It is also the intention of RMC that the remaining soil lead concentration at the bottom of each removal area on the RMC property be less than 920 mg/kg as determined through post excavation sampling at the bottom of the excavation area.

No excavation sidewall sampling or sampling beyond the horizontal limits of the excavation is required. Bottom confirmatory samples will be performed by the QA Representative utilizing an XRF with a minimum 20 percent of the samples sent off-site for laboratory analysis. The number of bottom samples required within each excavation area is listed on table presented on Sheet 7 of the design drawings and the actual locations will be determined randomly utilizing a 10 foot by 10 foot grid superimposed over the excavation area.

Samples for XRF analysis will be collected utilizing decontaminated or disposable sampling equipment from a depth interval of 0-6 inches. The samples will be placed into separate clean plastic baggies and homogenized by hand (protected by a clean glove) for approximately 1 minute. After homogenization the XRF will be utilized to analyze the sample for lead in accordance with the USEPA's SW-846, Method 6200. Five readings will be taken from each sample and recorded in the fieldbook and the results averaged to provide the uncorrected representative concentration. A minimum of 20 percent of the soil samples will be submitted to the Quality Assurance Analytical Laboratory for total lead analysis. The laboratory results will be evaluated against the corresponding average XRF concentration and a correction factor (regression equation) will be developed. The correction factor will be applied to those XRF sample results without a corresponding laboratory result. Utilizing the available laboratory results and the corrected average results for each sample, the 95% UCL for each remediation area will be calculated and compared against the 920 mg/kg PRG. If the 95% UCL is less than 920 mg/kg then the excavation area will be deemed complete. If the 95% UCL is greater than 920 mg/kg then additional excavation will be performed within portions of the excavation area as designated by the QA Representative. The amount of additional removal will be determined by the QA Representative based on the observed sampling results and visual conditions within the excavation. After re-excavation the remediated portions will be resampled at locations approximating the locations of the previous samples and analyzed with the XRF following the same protocol described above. The average XRF result will be corrected using the correction factor and the 95% UCL recalculated. This process shall be repeated until acceptable results are achieved.

If distinct layers or pockets of slag or battery casing materials are observed in the bottom or sidewalls of the excavation area, the QA Representative will require selective removal of the identified material.

2.2 OFF-SITE

The removal depths shown on Sheet 8 of the design drawings have been selected to remove the soil and sediment materials which exceed 400 mg/kg. No sidewall sampling or sampling beyond the horizontal limits of the proposed excavation is required, except along the southern limit of excavations areas AMT-1, 2 and 3. Completeness of the vertical removal, and southern limit of excavation areas AMT-1, 2 and 3, will be determined using the XRF with 20% laboratory confirmation as described above. The number of bottom samples required within each excavation area is listed on table presented on Sheet 8 of the design drawings. Sidewall samples shall be collected at a minimum frequency of once every 20 feet of side wall, but no less than 3 measurements will be taken in any excavation. Where sidewalls exhibit distinct horizons as determined by the QA Representative based on soil texture, color and structure, sidewall sampling shall be performed separately for each horizon. Side wall samples shall be collected across a 6-inch increment for the horizon represented by the sample.

Results of the XRF analysis within each excavation area will be averaged, adjusted utilizing the correction factor and the 95% UCL calculated. The calculated 95% UCL will be compared against 400 mg/kg. If the average exceeds 400 mg/kg, then additional removal will be required. The amount of additional removal will be determined by the QA Representative based on the observed sampling results. Following additional removal, the confirmatory sampling process will be repeated for those areas subject to additional removal at locations approximating the previous confirmatory sample location. In addition, if distinct layers or pockets of slag or battery casing materials are observed in the bottom or sidewalls of the excavation area, the QA Representative will require selective removal of the identified material.

2.3 HAZARDOUS WASTE MANAGEMENT UNITS

The proposed removal depths shown within the former HWMUs have been established based on the results of the soil sampling. Horizontal limits have been defined based on the regulatory limits (e.g. edge of the HWMU) and physical limits (such as building walls) of the units. Where the boundary of a proposed excavation area is not defined by a regulatory or physical limit, the area has been delineated based on professional judgment and interpretation relative to surrounding results.

The HWMUs are being clean-closed to the soil contaminant levels listed above, following the general procedures established in the IDEM RISC Program. In accordance with those requirements, confirmatory samples must be collected from the bottoms and sidewalls of the excavations.

The number of locations screened on the bottom of the excavations will be determined by the area of each excavation and will follow IDEM standard guidance for post-excavation sampling set forth in the IDEM RISC Technical Guide. The area of each excavation and number of screening locations is provided on Sheet 6 of the design drawings.

Sidewall screening will also be performed in all HWMU excavations according to IDEM guidance documents, by performing screening every 20 feet. However, no screening will be performed on sidewalls that terminate at the regulatory limit of the HWMUs or on HWMU sidewalls that are scheduled to be excavated deeper than the exposed sidewall in question. The numbers of sidewall screening locations for each HWMU are shown on Sheet 6. A random number generator will be used to determine which nodes of each 10-foot by 10-foot grid will be screened.

Samples for XRF analysis will be collected utilizing decontaminated or disposable sampling equipment from a depth interval of 0-6 inches below the bottom of the excavation. The samples will be placed into separate clean plastic baggies and homogenized by hand (protected by a clean glove) for approximately 1 minute. After homogenization the XRF will be utilized to analyze the sample for lead, arsenic, antimony, cadmium and selenium, in accordance with the USEPA's SW-846, Method 6200. Five readings will be taken from each sample and recorded in the fieldbook and the results averaged to provide the uncorrected representative concentration. A minimum of 20 percent of the soil samples will be submitted to the Quality Assurance Analytical Laboratory for total lead analysis. The laboratory results will be evaluated against the corresponding average XRF concentration and a correction factor (regression equation) will be developed for each parameter. The correction factor will be applied to those XRF sample results without a corresponding laboratory result. Utilizing the available laboratory results and the corrected average results for each sample, the 95% UCL for each remediation area will be calculated and compared against the soil standards listed in the CM Design Report. If the 95% UCL is less than the soil standards then the excavation area will be deemed complete. If the 95% UCL is greater than the soil standards then additional excavation will be performed within portions of the excavation area as designated by the QA Representative. The amount of additional removal will be determined by the QA Representative based on the observed sampling results and visual conditions within the excavation. After re-excavation the remediated portions will be resampled at locations approximating the locations of the previous samples and analyzed with the XRF following the same protocol described above. The average XRF result will be corrected using the correction factor and the 95% UCL recalculated. This process shall be repeated until acceptable results are achieved.

If distinct layers or pockets of slag or battery casing materials are observed in the bottom or sidewalls of the excavation area, the QA Representative will require selective removal of the identified material.

APPENDIX B

EARTHWORK

APPENDIX B

EARTHWORK

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1.0 INTRODUCTION

1.1 TERMS OF REFERENCE

1.1.1 Purpose

This appended section of the Construction Quality Assurance Plan (CQAP) addresses quality assurance requirements for earthwork operations during implementation of the Corrective Measures at the RMC facility Beech Grove, Indiana. The appendix details construction monitoring activities, soil sampling, soil testing and documentation.

1.1.2 References

ASTM D 421	Test Method for Dry Preparation for Soil Samples for Particle-Size Analysis and Determination of Soil Constants.
ASTM D 422	Test Method for Particle-Size Analysis of Soils
ASTM D 698	Test Method for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using a 5.5-lb (249-kg) Rammer and 12-inch (305-mm) Drop.
ASTM D 1556	Test Method for Density of Soil In Place by the Sand-Cone Method
ASTM D 1557	Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in. (457-mm) Drop
ASTM D 2487	Test Method for Classification of Soils for Engineering Purposes

ASTM D 2922	Test Methods for Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	Test Method for Water Content of Soil and Rock In Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

1.2 MEETINGS

To maintain a high degree of quality during earthwork operations, open channels of communication are required. Project Progress Meetings will be conducted as required by Specification Section 01200.

2.0 SOIL EVALUATION

The Contractor will provide as a pre-construction submittal laboratory analytical and geotechnical results for each of the proposed off-site soil and topsoil borrow sources proposed for use on this project. The soil evaluation shall be repeated each time a material variation is noted by the QA Representative in the field and for each new borrow source. The Contractor shall submit the samples to an independent laboratory for the following test:

GEOTECHNICAL PROPERTIES

Property	Test Method	Required Value
Gradation	ASTM D 422	Between 10% and 40% passing #200 sieve
Plasticity	ASTM D 4318	
Unified Soil Classification	ASTM D 2487	Sandy loam, loam, sandy clay loam, silty clay loam, loamy sand or silt loam
Modified Proctor Compaction	ASTM D 1557	
Atterberg Limits	ASTM D 423 and D 424	PI ≤20, LL ≤40

Note: Modified Proctor Compaction Analysis is not required for propose topsoil sources.

ANALYTICAL TESTING

Analyte	Method
Total Petroleum Hydrocarbons	EPA 1664A
Total Organic Halogens (TOX)	SW-846 9020B
Priority Pollutant Metals	SW-846 6010B/7471B
Priority Pollutant Pesticides/PCBs	SW-846 8081B/8082A

Priority Pollutant VOCs	SW-846 8260B
Priority Pollutant SVOCs	SW-846 8270C

Soil fill sources may not be from off-site industrial property borrow source. Quarry sources for aggregate and sand materials must be identified before the project begins and state-permitted borrow quarries are required.

Material which does not meet the project specifications and satisfaction of RMC shall not be used at the site. The QA representative, in consultation with the CM Engineer shall determine the acceptability of soil fill material with respect to the project specifications (Section 02210).

3.0 PLACEMENT AND COMPACTION

3.1 WEATHER CONDITIONS

Placement of soil fill shall be suspended if climatic conditions are inappropriate, as determined by the QA Representative. Precipitation and cold weather may prohibit fill placement. Soil fill shall not be placed when the material to be placed or the surface of the material in-place is frozen or wet.

3.2 FOUNDATION PREPARATION

Areas which are to receive soil fill shall be proofrolled prior to soil placement. Areas with free or standing water are to be considered unacceptable. Areas which exhibit excessive pumping or yielding shall be reworked and recompacted or undercut and replaced. The Contractor is responsible for the subrgade condition. The QA Representative shall determine and document the acceptability of soil fill areas.

3.3 FILL PLACEMENT

All cap soil fill shall be placed to the lines and grades shown on the project drawings. Survey controls required for earthwork placement shall be established by a professional surveyor. Controls shall be established based upon the vertical and horizontal reference system develop by the Contractor's Surveyor prior to soil remediation activities.

The QA Representative shall observe soil placement. Vegetation, organic matter, trash, debris, oversized stones or other unsuitable materials shall be removed from the fill soil. Imported soil fill with excessive quantities of deleterious material, as determined by the QA Representative, shall be removed from the site. Soil fill shall be placed in lifts with a loose lift thickness of 12 inches or less.

Successive layers of fill may not be placed until the preceding fill layer has been properly compacted, as determined by the QA Representative.

The QA Representative shall visually monitor the soil as delivered to the site. The QA Representative shall assure that the soil color, texture, consistency, gradation and plasticity are in accordance with the material accepted during the pre-construction evaluation. The QA Representative may require that the Contractor collect and re-analyze material samples to assure that the fill soil conforms with the project specifications and that the fill soil is the same material accepted by the pre-construction evaluation.

Fill soil samples shall be obtained by the Contractor at the frequency indicated below or whenever a variation in the fill material is observed. Samples shall be submitted to an independent laboratory to determine the following properties:

Property	Test Method	Frequency
Gradation	ASTM D 422	3,000 CY
Atterberg Limits	ASTM D 423 and 424	3,000 CY
Plasticity	ASTM D 4318	3,000 CY
Unified Soil Classification	ASTM D 2487	3,000 CY
Modified Proctor Compaction	ASTM D 1557	3,000 CY
Analytical Testing	(see Section 2.0)	5,000 CY (off-site)

Samples which have gradation, plasticity and material classification properties which vary significantly from those determined during the soil evaluation shall be re-tested. The QA Representative shall determine the necessity for shear strength testing. Imported material which does not meet the project specifications shall be removed from the site. The QA Representative shall determine the acceptability of soil fill material with respect to the project specifications. Any discrepancies or questions shall be clarified with the CM Engineer.

The Earthwork Contractor is responsible for maintaining and protecting fill areas from damage until final completion of the project. Travel over fill areas shall be restricted to prevent rutting or other degradation. Completed fill areas that are damaged following placement shall be scarified, filled and re-compacted to the satisfaction of the QA Representative.

3.4 COMPACTION

Compaction shall be observed by the QA Representative. The QA Representative shall observe the compaction equipment, number of passes and completeness of coverage. Soil fill shall be compacted to at least 92% of the maximum dry density as determined by the modified Proctor test, ASTM D 1557. In addition to the compaction requirement, Cap Soil Fill shall have a moisture content ranging from -5% to +3% of the optimum.

The compaction characteristics for fill soils shall be determined by an independent laboratory retained by the Contractor. A sample shall be collected by the Contractor once for every 3,000 CY or when a significant material variation is noted. The compaction characteristics shall be determined, including maximum dry density and optimum moisture content, according to ASTM D 1557. The resultant information will establish field compaction criteria.

The QA Representative shall determine the acceptability of soil compaction. Evaluation shall be based upon visual observation of material stability and in-place density testing. In-place density testing shall be performed by the Contractor's Quality Control representative by nuclear density methods, ASTM D 2922 and D 3017, at a frequency of once for every 1,000 SF placed and once per lift. If nuclear density methods are determined to be inappropriate, in-place density shall be determined according to ASTM D 1556. In-place density results must be included with daily project reports. Any soil reworking and re-compaction, as determined by the QA Representative, shall be performed by the Contractor.

3.5 ANCHOR TRENCH

The Contractor shall excavate and backfill the anchor trench for the cap systems geosynthetics and anchor trench drain according to the project specifications and quality assurance procedures outlined in the accompanying Construction Quality Assurance Plan for Geosynthetic Lining System Installation. The QA Representative shall observe anchor trench construction and backfilling.

4.0 EARTHWORK ACCEPTANCE

4.1 CONTRACTOR

The Contractor retains all ownership for the soil fill until accepted by the RMC. The Contractor remains responsible for the condition of the soil subbase until the geosynthetic lining system is installed.

4.2 RMC

RMC will accept soil fill when:

1. Soil evaluation testing is complete and the soil fill has been shown to meet project specifications.

2. Placement and compaction is completed.

3. In-place density results, daily field reports and compaction test data have been submitted.

4. As-built drawings, sealed by a registered Professional Surveyor, have been received by the Owner. As-built drawings should show elevations of the starting ground surface, bottom of excavations, restored ground surface, bottom of containment cell, top of waste in containment cell and top of cap.

APPENDIX C

GEOSYNTHETICS INSTALLATION

APPENDIX C

GEOSYNTHETICS INSTALLATION

Final CM Design
Refined Metals Corporation
Beech Grove, Indiana
October 6, 2010

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LIST OF FORMS

1.0 INTRODUCTION

1.1 TERMS OF REFERENCE

1.1.1 Purpose

This manual addresses the Quality Assurance and Quality Control of the installation of high density polyethylene (HDPE) geomembrane and composite drainage net for Refined Metals Corporation Beech Grove (RMC). The manual delineates the quality procedures and standards required for production and installation.

For purposes of this document, the term "geomembrane" refers to the 60 mil textured HDPE geomembrane layer of the proposed containment cell cap as described in Section 02755 of the Specifications. The term "composite drainage layer" net shall mean the double side drainage layer as described in Section 02751 of the Specifications.

1.1.2 Quality Assurance

Quality Assurance is defined as a planned and systematic pattern of all means and actions designed to provide adequate confidence that items or services meet contractual and regulatory requirements and will perform satisfactorily in service. This section also provides a methodology for resolving problems which may occur during construction.

1.1.3 Quality Control

Quality Control is defined as those actions which provide a means to measure and regulate the characteristics of an item or service in accordance with contractual and regulatory requirements.

1.1.4 References

ASTM D 570	Test Method for Water Absorption of Plastics
ASTM D 638	Test Method for Tensile Properties of Plastics
ASTM D 746	Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D 792	Test Method for Specific Gravity (Relative Density) and Density of Plastics by Displacement
ASTM D 882	Test Method for Properties of Plastic Sheeting
ASTM D 1004	Test Method for Initial Tear Resistance of Plastic Film and Sheeting
ASTM D 1204	Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
ASTM D 1238	Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer
ASTM D 1505	Test Method for Density of Plastics by the Density-Gradient Technique
ASTM D 1603	Test Method for Carbon Black in Olefin Plastics
ASTM D 1682	Test Method for Strip Tensile Strength
ASTM D 1693	Test Method for Environmental Stress Cracking of Ethylene Plastics
ASTM D 2663	Test Method for Rubber Compounds-Dispersion of Carbon Black
ASTM D 3015	Test Method for Microscopical Examination of Pigment Dispersion in Plastic Compounds
ASTM D 4354	Standard Practice for Sampling of Geosynthetics for Testing
ASTM D 4437	Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes
ASTM D 4533	Test Method for Trapezoid Tearing Strength of Geotextiles
ASTM D 4595	Test Method for Tensile Properties of Geotextiles by Wide Width Strip
ASTM D 4632	Test Method for Breaking Load and Elongation of Geotextile (Grab Method)

ASTM D 4716	Test Method for Constant Head Hydraulic Transmissivity of Geotextiles and Geotextile Related Products
ASTM D 4759	Standard Practice for Determining the Specification Conformance of Geosynthetics
ASTM D 4833	Test Method for Index Puncture of Geotextiles, Geomembranes and Related Products
ASTM D 5084	Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
ASTM D 5321	Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosnythetic Friction by the Direct Sheer Method.

GRI Test Method GM6 - Pressurized Air Channel Test for Dual Seamed Geomembranes
NSF Standard 54 (1991 or current) Flexible Membrane Liners

2.0 GEOSYNTHETIC MANUFACTURING AND TRANSPORTATION

2.1 GEOSYNTHETIC PROPERTIES CERTIFICATION

2.1.1 Geomembrane Raw Material

The geomembrane manufacturer is responsible for the production of geomembrane rolls from resin.

Upon delivery, the following shall be furnished by the Manufacturer:

1. Reports on tests performed by the Manufacturer to verify the quality of the resin used in the geomembrane rolls proposed for use on the project. The tests should include the following:

Required Material Properties for HDPE

TEST	METHOD	NOTES	REQUIREMENTS
SPECIFIC GRAVITY (1)	ASTM D 792 OR D 1505	1 and 2	≥0.940
CARBON BLACK CONTENT	ASTM D 1603	2	2 to 3%
MELT INDEX	ASTM D 1238 (Condition E MAX)	1 and 2	0.3 g per 10 minutes

(1) Measure prior to adding carbon black.
(2) 1 per 50,000 square feet of 1 per resin batch whichever results in a more number of tests.

2.1.2 Geomembrane

The Installer shall submit certification that all geomembrane rolls brought to the site meet the following requirements or the Manufacturers minimum published values, whichever is more restrictive. Adherence to this requirement shall be made a condition of the material purchase order.

Required Material Properties for 60 mil Textured HDPE Geomembrane

PROPERTY	TEST METHOD	TYPICAL VALUE
Thickness, mils, Minimum 1. Overall	ASTM D1593	57
Density (g/cc), minimum	ASTM D 792 or D1505	0.94
Tensile Properties	ASTM D638-NSF Modified	
1. Strength at Yield (lb/in width), minimum		126
2. Strength at Break (lb/in width), minimum		90
3. Elongation at Yield (percent), minimum		12
4. Elongation at Break (percent), minimum		100
Tear Resistance (lb) minimum	ASTM D1004	39
Low Temperature Brittleness (°C), maximum	ASTM D 746	-60
Dimensional Stability, Percent Change, Maximum	ASTM D 1204 100°C, 1 hr	+/-2.0
Environmental Stress Crack (hrs) minimum	ASTM D1693-NSF Modified	1500
Puncture Resistance, lbs., Minimum	ASTM D4833	72
Carbon Black Content (%), range	ASTM D 1603	2.0 - 3.0
Carbon Black Dispersion	ASTM D3015-NSF Modified	A1, A2

For each geosynthetic material used at the site, the Installer shall provide the following to the QA Representative:

1. A properties sheet including specified properties and testing methods.
2. A certification that property values given in the properties sheet are guaranteed by the Manufacturer.
3. Geosynthetic delivery, storage, and handling instructions.
4. One quality control certificate for every roll of geomembrane. This certificate shall include roll numbers and identification. The finished rolls shall be identified by a number corresponding to the particular batch of resin used.

The following information shall also be provided by the Installer for any extrudate used for the project.

1. Certification stating that all extrudate is from the same Manufacturer and is of the same resin type as the geomembrane seamed.
2. Copy of quality control certificates issued by the Manufacturer

2.1.3 Geotextile

The Installer shall submit certification that geotextile rolls for use in the interior edge drain and liner system meet the following requirements or the Manufacturers minimum published values, whichever is more restrictive. Adherence to this requirement shall be made a condition of the material purchase order:

Required Material Properties of Geotextile for Interior Edge Drain

Properties	Test Method	Required Value
Grab Strength (lbs.), min.	ASTM D 4632	150
Puncture Resistance (lbs.), min.	ASTM D 4833	75
Tear Strength (lbs.), min.	ASTM D 4533	70
Mass per Unit Area (oz/sy), min.	ASTM D 3776	8
Apparent Opening Size (US Sieve No.)	ASTM D 4751	80

The Installer shall provide the QA Representative with a copy of geotextile manufacturer's recommended installation procedures to be followed during geotextile installation.

2.1.4 Geonet (Geocomposite)

The Installer shall submit certification that all geonet rolls brought to the site meet the following requirements or the minimum published values, whichever is more restrictive. Adherence to this requirement shall be made a condition of the material purchase order:

Required Material Properties of HDPE Geonet

Properties	Test Method	Required Value
Transmissivity (M^2/S), min.	ASTM D 4716 $i = 0.1$ $\sigma = 10{,}000$ psf	2×10^{-4}
Tensile Strength (lb/in), min.	ASTM D 1682 or D 4595	30

2.1.5 Interface Friction

The Contractor shall test geosynthetic and soil layers by shear box testing (ASTM D 5321) to demonstrate the following minimum values are met:

Representative sample of site soil to Textured Geomembrane	22°
Nonwoven Geotextile (Geocomposite) to Textured Geomembrane	22°
Nonwoven Geotextile (Geocomposite) to Proposed Cap Soil	22°

2.2 TRANSPORTATION AND HAULING

Geosynthetic rolls or panels shall be packaged and shipped by appropriate means so that no damage is caused. Transportation shall be the responsibility of the Installer.

2.2.1 Delivery

Off-loading and storage of the geosynthetics is the responsibility of the Installer. The Installer shall be responsible for replacing any damaged or unacceptable material at no cost to RMC. No off-loading shall be done unless the QA Representative is present. Any damage occurring during the off-loading shall be documented by the Installer and QA Representative. All damaged rolls shall be separated from undamaged rolls and stored at locations designated by the QA Representative until Installer can remove damaged materials from the site. The QA Representative will be the final authority on determination of damage. All unacceptable materials shall be removed from the site by the Installer.

The QA Representative shall visually inspect the surface of all rolls for defects and/or damage, unrolling only if necessary. Any flaws shall be immediately reported and documented.

The Installer shall take care that any equipment used in handling the geomembrane does not cause damage during the off-loading process. Appropriate handling equipment includes cloth chokers and spreader bars for loading, spreader and roll bars for deployment. Dragging panels on ground surfaces shall not be permitted. The Installer shall also assure that all personnel handle the geomembrane with care, so as not to damage the material. Geomembrane material shall not be folded; folded material shall be rejected.

Form 1 shows an example of a Material Delivery Report to be completed by the QA Representative.

2.2.2 On-Site Storage

Storage of geosynthetics shall protect them from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat, or any other damage.

Storage space shall be near the site to be lined, to minimize additional handling. It shall be protected against theft, vandalism, passing vehicles, and any other hazards.

Geosynthetic rolls shall be stored on prepared surface, i.e., a smooth surface without obstructions and/or debris, (not on wooden pallets). Geosynthetic rolls may be stacked per Manufacturers recommendations but no more than three rolls high.

2.3 MATERIAL CONFORMANCE

Independent material conformance testing is not required. The Installer shall submit certifications from the geosynthetic manufacturers that the material delivered to the site meet the requirements established in this CQAP and the Specifications. Geosynthetic materials may not be used until conformance certifications are received and approved by the QA Representative.

The QA Representative shall determine the acceptability of geosynthetic components. Determinations regarding the acceptability of materials not meeting the specifications can only be made by the Engineer.

3.0 GEOMEMBRANE INSTALLATION

3.1 EARTHWORK

Immediately prior to installation of the designed geosynthetic components of the cap system, the subbase surface shall be observed by the QA Representative and Installer. The decision to repair ruts or depressions, if any, shall be made by the QA Representative and Installer. The Contractor shall repair any unacceptable subbase.

All recommendations and work performed on the subbase prior to installation shall be recorded.

No liner shall be placed on surfaces not previously found acceptable to the QA Representative and Installer. If requested, the Installer must also provide USEPA and/or IDEM an opportunity to inspect the subbase prior to geosynthetic placement.

The Contractor shall be responsible for preparing and maintaining the subbase in a condition suitable for installation of the liner unless specifically agreed otherwise. Contractor responsibilities include:

1. Surfaces to be lined shall be smooth, and free of debris, roots, and angular or sharp stones larger than 2-inches. The subbase shall be compacted in accordance with the design specifications but in no event below the minimum required to provide a firm unyielding foundation sufficient to permit the movement of vehicles and welding equipment over the subbase without causing rutting. The subbase shall have no sudden or abrupt changes in grade.

2. Protection of the subbase from erosion and water ponding. Protection, if required, may consist of a thin plastic protective cover (or other material as approved by the QA Representative) installed over the completed subbase until such time as the placement of liner begins. The plastic sheeting must be removed prior to geosythetic deployment as the presence of the plastic may cause interface sliding or failure.

3. Cap anchor trench excavation and preparation.

4. All earthwork operations as detailed in the design specifications. Earthwork quality assurance shall also be performed in accordance with the Construction Quality Assurance Plan for Earthwork.

3.2 ANCHOR TRENCH

3.2.1 Excavation

The cap anchor trench shall be excavated to the line, grade, and width shown on the construction drawings, prior to cap system geosynthetic placement. The QA Representative shall verify that the anchor trench has been constructed according to the project drawings. The anchor trench shall be excavated by the Contractor. If anchor trench is excavated in a clayey soil susceptible to desiccation, no more than the amount of trench required for the lining system to be anchored in one day shall be excavated to minimize desiccation potential of the anchor trench clay soils. Rounded corners shall be provided in and at the top of the trench so as to avoid sharp bends in the geomembrane.

3.2.2 Backfilling

The anchor trench shall be adequately drained to prevent ponding or otherwise softening of the adjacent soils while the trench is open. The anchor trench shall be backfilled by the Earthwork Contractor as outlined in the project specifications. Care should be taken when backfilling the trenches to prevent any damage to the cap geosynthetics or drainage pipe. If damage occurs, it shall be repaired by the Installer prior to the completion of the backfill.

3.3 WEATHER CONDITIONS

Welding shall not take place during any precipitation, in the presence of excessive moisture i.e., fog, dew, frost, in areas of ponded water or in presence of excessive winds, (unless wind barriers are provided).

Seaming may proceed if the geomembrane sheet temperature is above 32°F (0°C), or if it can be proven via test strips that good seams can be fabricated at lower temperatures. The QA Representative shall determine the acceptability of cold weather seaming.

Seaming may proceed if the sheet temperature is below 122°F (50°C), or if it can be proven via test strips that quality seams can be fabricated at higher temperatures. The QA Representative shall determine the acceptability of hot weather seaming. Sheet temperature should be measured by an infrared thermometer or surface contact thermocouple.

3.4 METHOD OF PLACEMENT

3.4.1 Installer Responsibility

The Installer shall be responsible for the following:

1. No equipment or tools shall damage the geosynthetic by handling, trafficking, or other means.

2. No personnel working on the lining system shall smoke, wear damaging shoes, or engage in other activities that could damage the geosynthetics.

3. The method used to unroll the panels shall not cause scratches or crimps in the geomembrane and shall not damage the supporting soil.

4. The method used to place geomembrane panels shall minimize wrinkles. Wrinkles shall be identified as to proper location by the Installer and shall be shown on the Installer's as-built drawings. Ballast shall be used to prevent relocation of the compensating wrinkles by wind.

5. Bridging shall be removed, unless accepted by the QA Representative.

6. Adequate loading (i.e., sandbags) shall be placed to prevent uplift by wind. (In case of high winds, continuous loading is recommended along the edges of panels to minimize risk of wind flow under the panels).

7. Direct contact with the geomembrane shall be minimized, i.e., the geomembrane in traffic areas is to be protected by geotextiles, extra geomembrane, or other materials approved by the QA Representative.

8. Panels shall not be skewed from the vertical unless presented in the panel layout plan and approved by the CM Engineer.

3.4.2 Field Panel Identification

A field panel is the unit area of geomembrane which is to be seamed in the field, i.e., a field panel is a roll or a portion of a roll cut in the field. Each field panel shall be given an "identification code" consistent with the layout plan. This code shall be as simple and logical as possible.

3.4.3 Field Panel Placement

Field panels are installed at the locations indicated by the layout plan. Field panels may be installed in either way:

1. All field panels are placed prior to field seaming. No more panels may be placed than can be seamed by the end of the day.

2. Field panel are placed one at a time, and each panel is seamed immediately after its placement (in order to minimize the number of unseamed field panels).

Each panel placement should be recorded immediately using the daily deployment report. Identification code, location and date shall be recorded. Form 2 is used as a record of daily deployment. Form 2 shall be completed by the QA Representative. All panels that are folded shall be replaced by the Installer.

3.5 FIELD SEAMING

3.5.1 Procedures

The welding or seaming procedure consists of overlapping the two geomembrane sheets such that any liquid flowing across the seams would flow from the top panel to underlying panel.

Seams shall be oriented parallel to the slope, i.e., oriented along, not across the slope. In corners and odd shaped geometric locations, the number of field seams should be minimized.

Seams shall be aligned with the least possible number of wrinkles and "fishmouths." If a "fishmouth" or wrinkle is found, it shall be cut, removed and patched.

Personnel performing field seaming shall meet the following requirements:

1. Master Seamer Qualifications: The Master Seamer shall have completed a minimum of 500,000 square feet of geomembrane seaming work using the type of seaming apparatus proposed for use on this project.

2. Other Seamer Qualifications: Other seamers shall have seamed a minimum of 100,000 square feet of geomembrane.

3. The Master Seamer shall provide direct supervision over other seamers.

Details of each seam, including seamer, machine number, time, and temperature shall be recorded by the QA Representative on the Pre-Weld and Geomembrane Seaming Record (Form 4).

3.5.2 Pre-Weld/Trial Weld

Pre-welds or trial welds shall be taken to verify the performance of welding equipment, seaming methods, and conditions. No seaming equipment or seamer shall be allowed to perform production welds until equipment and seamers have successfully completed trial weld(s). Pre-welds should be made in the same surroundings and environmental conditions as the production welds, i.e., in contact with the subgrade. Pre-welds shall be performed at the following frequency:

1. At all start-ups and prior to planned shut-downs.
2. Throughout the day as equipment requires start-up after a breakdown.

Samples should be at least 3 feet long and 1 foot wide with the seam centered lengthwise. (Typically the samples are made by the welder seaming two piece of the geomembrane together). Ten one-inch wide strips should be cut from the trial weld.

Specimens should be quantitatively tested by the Installer for peel adhesion for bonded seam strength (shear) using a recently calibrated field tensiometer. A specimen is considered to pass when the test results are consistent with test requirements established in Section 3.7.

A trial weld sample shall be considered passing if at least eight specimens pass peel and shear tests. Five shall be tested in peel mode and five in sheer mode.

Repeat the trial weld in its entirety when any of the trial weld samples fail in either peel or shear. When repeating trial welds fail, seaming apparatus and seamer shall not be used for production welding until deficiencies or conditions are corrected and two consecutive successful trial welds are achieved.

All trial welds shall be recorded by the QA Representative on Form 3 (Pre-Weld and Geomembrane Seaming Record).

3.5.3 Equipment

Hot dual wedge welders and hand held extrusion welders are the pieces of equipment approved for field seaming. The Installer is expected to utilize the dual wedge welder to the maximum extent possible and utilize the hand held extrusion welder for patches and finishing work.

Hot Wedge Welding

Consists of placing a heated wedge, mounted on a self propelled vehicular unit, between 2 overlapping sheets which are heated above the polyethylene's melting point. After being heated by the wedge, the overlapping panels pass through a set of preset pressure wheels which compress the panels together to create a fusion weld. A dual track wedge welder will create two fusion welds separated by an unwelded channel.

The double wedge fusion welder shall be equipped with a temperature readout device which continuously monitors the temperature of the wedge.

Other equipment used during seam operations includes field tensiometer, rotary grinders, electric generators, coupon die and press and manometers/air pumps.

A recently calibrated field tensiometer shall be used for sheer and peel testing. The device shall have a load range of 0 to 500 pounds, a peak hold function and digital readout. Speed settings or 2" or 20" per minute shall be available.

Properly functioning portable electric generators must be available within close proximity of the seaming region and with adequate extension cords to complete the entire seam. These generators should be of sufficient size or numbers to handle all seaming electrical requirements. The generator must have rubber tires, be placed on a smooth plate such that it is completely stable that no damage can occur to the geomembrane or to the underlying liner or subgrade material. Fuel (gasoline or diesel) for the generator must be stored away from the geomembrane and if accidently spilled on the geomembrane must be immediately removed. The area should be inspected for damage to the geomembrane and repaired if necessary.

If applicable, manometers for testing air channel welds provided with a heavy duty needle or other approved pressure feed device, an air pump shall be provided. Two manometers shall be used in the Air-Pressure test.

A coupon die and press shall be supplied for cutting peel and shear specimens for trial seaming.

3.5.4 Seam Preparation

For wedge welding, seam preparation shall include:

1. The panels of the geomembrane shall be overlapped at least four-inches.

2. The seam area shall be cleaned prior to seaming to assure the area is clean and free of moisture, dust, dirt and debris of any kind. No grinding is required for fusion welding.

3. The panels shall be adjusted so that seams are aligned with the fewest possible number of wrinkles and "fishmouths."

4. A moveable protective layer may be used directly below the overlap of geomembrane that is to be seamed to prevent build-up of moisture between the panels.

3.6 NON-DESTRUCTIVE SEAM TESTING

Purpose of non-destructive testing is to check the continuity of the seam. The Installer shall non-destructively test all field seams over their full length. All test equipment shall be furnished by the Installer.

3.6.1 Vacuum Box Testing

Equipment for vacuum box testing shall consist of the following:

1. A vacuum box assembly consisting of a rigid housing, a transport viewing window, a soft neoprene or rubber gasket attached to the bottom, a valve assembly, and a vacuum gauge.

2. A steel vacuum tank and pump assembly equipped with a pressure controller and pipe connections.

3. A rubber pressure/vacuum hose with fittings and connections.

4. A plastic bucket and wide brush (or spray assembly).

5. A soapy solution.

The following procedure shall be used by the Installer:

1. Excess sheet overlap (if any) shall be trimmed away.

2. The window and gasket surfaces shall be cleaned and checked for leaks.

3. The vacuum pump shall be energized and the tank pressure shall be reduced to approximately 5 psi.

4. A strip of the geomembrane shall be wetted approximately 12 inches by 48 inches (length of the box) with a soapy solution. Size of the wet area depends on the size of the vacuum box.

3. The box shall be placed over the wetted area and compressed. Steel reinforcement that comes in contact with the liner shall not have any burs, sharp points, etc.

4. The bleed valve shall be closed and the vacuum valve shall be opened.

5. It shall be verified that a tight seal is created.

6. For a period of approximately 15 to 30 seconds, the geomembrane shall be examined through the viewing window for the presence of soap bubbles.

7. If no bubbles appear, the vacuum valve shall be closed, the bleed valve shall be opened, and the box shall be moved to the adjoining area with a minimum of 3 inches overlap. The process shall then be repeated.

8. All areas where soap bubbles appear shall be marked and repaired and then retested.

9. Vacuum box results should be recorded by the QA Representative on the Non-Destructive Seam Testing Form (Form 4). All vacuum box test shall be observed by the QA Representative.

3.6.2 Air-Pressure Testing

Air pressure testing is applicable to those processes which produce a double seam with an enclosed space. This method should be used by the Installer rather than vacuum box testing, to the maximum extent possible.

Equipment for testing air-pressure testing shall include:

1. An air pump equipped with a pressure gauge capable of generating and sustaining a pressure between 25 to 30 psi and mounted on a cushion to protect the geomembrane. The air pump may be manual or motor driven.

2. A manometer equipped with a sharp hollow needle, or other approved pressure feed device.

The following procedures shall be followed by the Installer:

1. Both ends of the seam area to be tested shall be sealed.

2. A manometer or other approved pressure gauge shall be inserted into both ends of the channel created by the double wedge or extrusion double wedge fusion welds. Means of pressurizing must be provided.

3. The air pump shall be energized to verify the unobstructed passage of air through the channel. The QA Representative shall verify unobstructed air flow.

4. The air pump shall be energized to pressure between 25 and 30 psi, the valve shall be closed, and the pressure shall be sustained for 5 minutes.

5. If there is a loss of pressure exceeding 4 psi, or the pressure does not stabilize, the faulty area shall be located, repaired, and retested.

6. The needle or other approved pressure feed device shall be removed and the hole sealed. The air channel at the other end shall be opened to insure that air pressurized the entire channel prior to removing the feed device.

7. Test results shall be recorded by the QA Repersentative on the Non-Destructive Air Pressure Seam Testing Summary (Form 4).

3.7 DESTRUCTIVE SEAM TESTING

Purpose of destructive testing is to determine and evaluate seem integrity and assess long-term performance.

3.7.1 Location and Frequency

The Installer shall provide the QA Representative with minimum of one destructive test sample per 500 feet of seam length from a location specified by the QA Representative; individual samples may be taken at greater or lesser intervals.

Additional destructive tests may be taken in areas of contamination, offset welds, visible crystallinity or other potential cause of faulty welds, as determined by the QA Representative.

The seaming technician (or Installer) shall not be informed in advance of the locations where the seam samples will be taken.

3.7.2 Sampling Procedure

In order to obtain test results prior to completion of liner installation, samples shall be cut by the Installer as seam progresses at the locations designated by the QA Representative.

The Installer shall mark all samples with the date and seam sample number. The Installer should also record, the date, location, time, and seam number for each specimen taken.

All holes in the geomembrane resulting from obtaining the seam samples shall be immediately repaired. All patches shall be vacuum tested. Sample locations should be located on the as-built drawing. All destructive seam samples shall be recorded by the QA Representative on the Destructive Sample Record (Form 5). Information to be recorded includes date, sample number, seam number, machine number, seamer, date sent to lab and a summary of any field test performed.

3.7.3 <u>Size of Samples</u>

The samples shall be 18 inches wide by 36 inches long with the seam centered lengthwise. This sample is usually cut in thirds, two pieces given to the QA Representative and the other given to the liner Installer. The QA Representative shall send one sample to an independent laboratory for testing. The other sample will be archived by the QA Representative in the event future testing is required.

3.7.4 <u>Seam Testing Requirements</u>

Destructive testing involves two techniques: Shear strength and peel adhesion. Destructive testing will be conducted by the Installer and QA Representative.

Shear testing will be performed in accordance with ASTM D 4437-NSF modified. This test involves placing a tensile stress from the top sheet through the weld and into the bottom sheet. Peel testing shall be performed in accordance with ASTM D 4437-NSF modified. This test involves peeling the sheets apart to observe how separation occurs. Results indicate whether or not the sheets are continuously and homogeneously connected through the seam.

Ten 1-inch wide replicate specimens shall be cut from the sample. Five specimens shall be tested for shear strength and five for peel adhesion. The test seam area will be considered acceptable if four of the five samples for each test fail outside of the seam area, provided all five samples must meet the following strength requirements:

<u>SEAM PROPERTIES FOR 60 MIL TEXTURED HDPE GEOMEMBRANE</u>

TEST	TEST METHOD	FAILURE CRITERIA
Shear Strength	ASTM D4437-NSF Modified	120 lb/in (minimum), FTB, greater than 100% elongation
Peel Adhesion	ASTM D4437-NSF Modified	78 lb/in minimum, FTB, less than 10% separation

3.7.5 Independent Laboratory Testing

The QA Representative shall package and ship to the independent laboratory, one section of every seam sample taken for third party determination of seam integrity. The samples shall be tested in accordance with the seam testing requirements. Discrepancies between project seam requirements and Manufacturer's requirements will be handled by adopting the most stringent requirement.

3.7.6 Procedures for Destructive Test Failure

One of the following procedures shall apply whenever a sample fails a field destructive test:

1. The Installer shall cap strip the seam between the failed location and any passed test location.

2. At the QA Representative discretion, the Installer can retrace the welding path to an intermediate location (at a minimum of 10 feet from the location of the failed test), and take a sample for an additional destructive seam test. If this test passes, then the seam shall be cap stripped between that location and the original failed location. If the test fails, the process is repeated.

3. Over the length of seam failure, the contractor shall either cut out the old seam, reposition the panel and reseam, if possible, or add cap strip, as required by the QA Representative.

The QA Representative shall document all actions taken in conjunction with destructive test failures.

3.8 DEFECTS AND REPAIRS

3.8.1 Identification

All seams and the entire geomembrane surface shall be observed by the QA Representative for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. Unacceptable panels shall be removed and replaced. Because light reflected by the geomembrane helps detect defects, the surface of the geomembrane shall be clean at the time of observation. Reflecting light will cause the surface of the geomembrane, at locations where there are imperfections, to appear white or light in color. The geomembrane surface shall be brushed, blown, or washed by the Installer if the amount of dust or mud inhibits observation, as determined by the QA Representative.

3.8.2 Evaluation

Any suspect locations shall be non-destructively tested as appropriate in the presence of the QA Representative. Each location that fails the non-destructive testing shall be marked by the QA Representative, and repaired accordingly.

3.8.3 Repair Procedures

Any portion of the geomembrane exhibiting a flaw or failing a destructive or non-destructive test shall be repaired.

1. Defective seams shall be restarted/reseamed as described in these specifications.

2. Long lengths of failed seams shall be capstripped.

3. Tears shall be repaired by patching. Where the tear is on a slope or an area of stress and has a sharp end it must be rounded by cutting prior to patching.

4. Blisters, holes, undispersed raw materials, and contamination by foreign mattery shall be repaired by large patches.

5. Surfaces of the geomembranes which are to be patched shall be cleansed and lystered.

6. Folds shall be removed or patched.

Patches shall be round or oval in shape, made of the same geomembrane, and extended a minimum of 6 inches beyond the edge of defects. All patches shall be the same compound and thickness as the geomembrane specified. All patches shall have their top edge beveled with a grinder prior to placement on the geommembrane. Patches shall be applied using approved methods only.

All surfaces must be clean and dry at the time of repairs. All seaming equipment used in repairs must be approved by the QA Representative and Installer. All repair procedures, materials, and techniques shall be approved in advance of the specific repairs by the QA Representative and Installer.

Form 6 (FML Repair Locations) shall be used by the QA Representative for documenting repairs.

3.8.4 Verification of Repairs

Each repair shall be non-destructively tested. Repairs that pass the non-destructive test shall be taken as an indication of an adequate repair. Failed tests indicate that the repair shall be repeated and retested until passing test results are achieved. The QA Representative shall take additional destructive seam samples, as necessary, for long lengths of cap stripped seam.

Recording of results: daily documentation of all non-destructive and destructive tests shall be prepared by the QA Representative. This documentation shall identify all seams that initially fail destructive testing and indicate evidence that these seams were repaired and successfully retested. Documentation shall identify all patch, bead or cap strip locations and indicate that repairs were made and successfully tested.

Repair documentation shall include:

1. Panel and seam location.

2. The type of repair, i.e., patch, bead, cap strip, etc.

3. Identification of any cap strips that are repairs for failing a destructive seam test.

4. Vacuum test results on repairs.

5. Precise location of the repair.

4.0 GEOCOMPOSITE AND GEOTEXTILE INSTALLATION

4.1 HANDLING AND PLACEMENT

The geocomposite (geotextile/geonet/geotextile), geonet and geotextile shall be handled in a manner to ensure it is not damaged. Prior to and during placement, the Installer and QA Representative shall assure that:

1. The portion of the geomembrane to be covered by the composite drainage layer, geonet or geotextile has all required documentation complete.

2. The surface of the geomembrane must not contain stones or excessive dust that could cause damage. Prior to placing the composite drainage layer, the liner shall be swept clean with a soft bristle broom.

3. In the presence of winds, all geosynthetics shall be weighted with sandbags, as necessary. The Installer shall be responsible for damage caused by wind.

4. Geosynthetics shall be cut using an approved cutter, similar to a hooked razor blade. No straight blades are permitted. Care must be taken to protect underlying geomembranes if the geonet or geotextile is being cut in place.

5. Equipment used to deploy the geosynthetics shall not damage the materials or the underlying geomembrane.

6. No personnel working on the lining system shall smoke, wear damaging shoes, or engage in other activities that could damage the geosynthetics.

4.2 INSTALLATION

The Installer and QA Representative shall assure the following during geocomposite, geonet and geotextile seaming:

1. Overlap seams a minimum of six (6") inches.

2. Ties for the geonet are placed at three (3') foot intervals along the seam length. Only nylon ties which do not damage the underlying geomembrane are used; metal ties are not permitted.

3. Tying can be achieved by plastic fasteners. Tying devices shall be white or yellow for easy identification.

4. No horizontal seams are constructed on the side slopes.

5. For the geotextile component of the geocomposite sewing of the geotextile seam may be performed.

4.3 REPAIR PROCEDURES

Patching of the geonet shall be used to repair holes, tears, and defects. Patches shall provide 6" of overlap round the repaired area and shall be held in place with nylon ties. Geonet shall be removed if areas with large defects are observed. The QA Representative shall determine the acceptability of the geonet.

5.0 GEOSYNTHETIC ACCEPTANCE

5.1 INSTALLER

Installer retains all ownership and responsibilities for the geosynthetic until acceptance by the Owner.

5.2 OWNER

The Owner will accept geosynthetic installation when:

1. All required documentation from the Manufacturer and Installer has been received and approved.

2. The installation is complete.

3. Material conformance testing and destructive seam testing is complete.

4. Verification of the adequacy of all field seam and repairs, including associated testing, is complete.

5. Written certification documents, including drawings, sealed by a registered professional Engineer, have been received by RMC.

6. The Installer shall provide a final certification stating the installation has proceeded in accordance with the Specifications.

FORM 1

MATERIAL DELIVERY REPORT

PROJECT NAME: ______________________

PROJECT NUMBER: ______________________

LOCATION: ______________________

DATE: ______________________

MATERIAL TYPE: ______________________

ROLL NO.	BATCH NO.	RESIN TYPE	DESCRIPTION OF DAMAGE

COMMENTS: ______________________

OFF-LOADING PROCEDURES: ______________________

MATERIAL STORAGE: ______________________

FORM 2

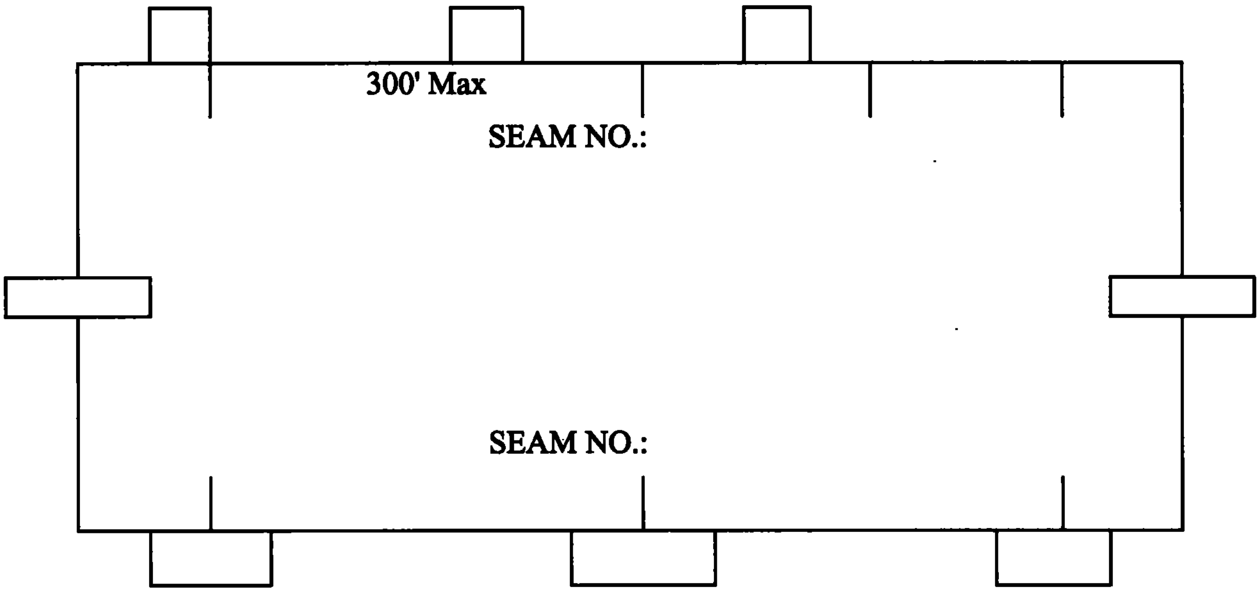
GEOMEMBRANE PANEL DEPLOYMENT LOG

PROJECT NAME:____________________ DATE DEPLOYED:__________________

PROJECT NUMBER:__________________ TEMP: Max:________F; Min:________F

LOCATION:________________________ WIND:________________ mph N S E W

ALL MEASURED IN MILS



SUB-GRADE ACCEPTED FOR AREA BENEATH PANEL NUMBER:

__________ Yes __________ No

REMEDIAL WORK REQUIRED:

__________ Yes __________ No

TYPE OF WORK REQUIRED: ____

____

____

REMEDIAL WORK COMPLETED AND AREA ACCEPTED:

____________________ Yes __________ No

COMMENTS: ____

____

____

PANEL NUMBER:________________
PANEL LENGTH:________________
ROLL NUMBER:________________

FORM 3

PRE-WELD AND GEOMEMBRANE SEAMING RECORD

PROJECT NAME: ____________________________
PROJECT NUMBER: ______________________
LOCATION: ______________________
DATE: ____________________
QA OFFICIAL: ______________________

WELDING MACHINE NUMBER:__________ WELDER'S NAME:_____________

Pre-weld Seam #	Time am/pm	Temp.	Temperature of		Results		Pass/ Fail*
			Welder	Extrudate	Peel	Shear	

COMMENTS:____

____

NOTE: USE ONLY ONE FORM PER WELDER.

* PASS OR FAIL RESULTS ARE FOR PRE-WELDS ONLY, TEST RESULTS FOR SEAMS ARE DOCUMENTED ON FORMS 4 AND 5.

FORM 4

NON-DESTRUCTIVE AIR PRESSURE SEAM TESTING

PROJECT NAME:________________________
PROJECT NUMBER:_______________________
LOCATION:____________________________

SEAM NUMBER	CQA	TIME	PSI	DATE	TIME	PSI	PASS/ FAIL *

* REPAIRS OF FAILED SEAMS ARE DOCUMENTED ON FORM 5

** EXTRUSION WELDED

FORM 5

DESTRUCTIVE SAMPLE RECORD

PROJECT NAME: ______________________________
PROJECT NUMBER: ______________________
LOCATION: ______________________

DATE	DS NO.	SEAM NO.	MACH NO.	OPER NAME	FIELD TEST		DATE TO LAB PKG SLIP NO. FEDEX/UPS
					PEEL	SHEAR	

FORM 6

GEOMEMBRANE REPAIR FORM

REPAIR DESIGNATION	DATE DAMAGE OBSERVED	DATE REPAIR CONDUCTED	SIZE	LOCATION OF REPAIR	REPAIRED TEST DATE	RESULT

APPENDIX D

SAMPLING AND ANALYSIS PLAN

APPENDIX D

SAMPLING AND ANALYSIS PLAN

Final CM Design
Refined Metals Corporation
Beech Grove, Indiana
October 6, 2010

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TABLE

1.0 INTRODUCTION

The Sampling and Analysis Plan (SAP) presented in this attachment provides the policies, procedures, organization, objectives, functional activities, and specific Quality Assurance/ Quality Control (QA/QC) procedures that shall be employed by Refined Metals Corporation (RMC), Advanced GeoServices Corp. (Advanced GeoServices), and the Remedial Contractor during sampling associated with the proposed corrective Measures for the RMC, Beech Grove, Indiana site to ensure that the technical data generated during the sampling are accurate and representative. A separate SAP specific to groundwater sampling is provided as an attachment to the Inspection and Maintenance Plan.

1.1 SAMPLING AND ANALYSIS PLAN ORGANIZATION

Section 1.0	–	Introduction
Section 2.0	–	Project Description
Section 3.0	–	Project Organization
Section 4.0	–	Quality Assurance/Quality Control Objectives
Section 5.0	–	Sampling To Be Performed
Section 6.0	–	Sampling Procedures
Section 7.0	–	Sample Custody
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Section 9.0	–	Laboratory Quality Assurance Program
Section 10.0	–	Data Reduction Validation and Reporting
Section 11.0	–	Internal Laboratory Quality Control Check Samples and Calculations
Section 12.0	–	Performance System Audits
Section 13.0	–	Preventative Maintenance
Section 14.0	–	Specific Routine Procedures Used to Assess Data Precision, Accuracy and Completeness

Section 15.0 – Corrective Action

2.0 PROJECT DESCRIPTION

2.1 PROJECT BACKGROUND

The Refined Metals Corporation (RMC) Beech Grove facility (Site) was the location of a secondary lead smelting and refining operation from 1968 through 1995. The general location of the site is shown on Figure 1 of the CM Design Report and a detailed plan of the Site is shown on Sheet 1 of the design drawings. During its operational life, the facility handled hazardous materials or hazardous wastes under the Resource Conservation and Recovery Act (RCRA). These primarily consisted of lead acid automotive and industrial batteries, and lead-bearing materials that were processed for lead recovery.

In accordance with the requirements of RCRA, the facility completed and submitted a RCRA Part A permit application. On November 19, 1980 the facility was granted approval to operate two hazardous waste management units under Interim Status: 1) indoor waste piles; and 2) outdoor waste piles. Facility documents also identify a surface impoundment (lagoon) as a RCRA permitted unit; however, it does not appear to have been included on the Facility Part A permit until after 1991. The Surface Impoundment was, and still is, used to collect and manage facility storm water runoff. See Sheet 1 of the design drawings for the location of the RCRA Hazardous Waste Management Units (HWMUs).

The former indoor and outdoor waste piles were removed when normal facility operations ceased. The site sat idle after December 31, 1995 except for the wastewater treatment system which remained in operation to collect and manage storm water runoff from the lagoon and other site areas. Between August 2009 through early-January 2010 all buildings and structures were decontaminated and demolished, with the exception of four pump houses and the lagoon which were decontaminated, but remain in operation for on-site storm water management. Decontamination and demolition activities were performed in accordance with the *Draft*

Decontamination and Demolition Plan (Advanced GeoServices March 4, 2009) and the *Decontamination and Demolition Implementation Plan* (Focus Contracting, June 8, 2009) both of which were submitted, reviewed and approved by the USEPA and IDEM. A summary report of the decontamination and demolition activities is being prepared on a parallel track with preparation of this CM Design submission and will be included as an attachment to the Corrective Measures Completion Report to be provided following completion of the Corrective Measures.

Throughout the decontamination and demolition process storm water continued to be collected, treated as appropriate, and discharged to the City of Indianapolis POTW. Storm water sampling performed after completion of site cleaning activities has demonstrated that storm water from the lagoon and cleaned surface areas of the site can be discharged without requiring pre-treatment. In an effort to reduce the hydraulic loading on the POTW, the City of Indianapolis has requested that RMC cease discharge of the clean storm water to the sanitary sewer following completion of decontamination and demolition activities. At this time RMC has submitted a request for a "No Exposure Certification for Exclusion from NPDES Storm Water Permitting" to allow surface discharge of the storm water currently sent to the POTW. If storm water currently sent to the POTW will be surface discharged, it will most likely be sent to the drainage ditch at the north end of the property using the existing system of pumps and internal conveyance piping. RMC is also requesting approval from the City of Indianapolis to continue storm water discharge to the POTW until appropriate approvals for surface water discharge can be secured.

3.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The overall responsibility for the project is assigned to Mr. Matthew Love of Exide Technologies, representative of RMC. In this capacity, Mr. Love is responsible for the overall performance of the project including ensuring that the project is conducted in accordance with the Consent Decree and the Corrective Measures (CM) Design Report. This includes confirming that the Contractor, the QA Representative, and the contracted laboratory all conduct its operations in compliance with the CM Design Report. The Information Gathering activities will be performed by Advanced GeoServices, under the direction of RMC. The remedial activities will be performed by a Contractor selected based on cost and qualifications.

Construction Quality Assurance (QA) oversight will be the responsibility of RMC. Construction Quality Assurance services are expected to be provided by Advanced GeoServices utilizing personnel experienced in construction and remediation projects.

4.0 QUALITY ASSURANCE/QUALITY CONTROL OBJECTIVES

Site activities performed by the project team at the Site will incorporate, but not be limited to, the QA/QC procedures established herein during the removal activities.

In combination, QA and QC represent a set of procedures designed to produce analytical data of known and acceptable quality. A useful distinction between QA and QC programs can be made as follows: the QC program ensures that all information, data, and decisions resulting from the investigation are technically sound and properly documented, while the QA program assures that the QC program achieve its goals.

Data Quality Objectives (DQOs) are quantitative and qualitative statements specifying the quality of the environmental data required to support the decision making process. Separate DQOs are designed for field sampling and laboratory analysis so that clear distinctions between any problems found in the system can be isolated with respect to cause. Conversely, the DQOs are also designed to provide an indication of the variability of the overall system. The overall QA objective is to keep the total uncertainty within an acceptable range that will not hinder the intended use of the data. To achieve this, specific data requirements such as detection limits, criteria for precision and accuracy, sample representativeness, data comparability and data completeness (PARCC) are specified below.

4.1 PRECISION

Precision measures the reproducibility of data or measurements under specific conditions. Precision is a quantitative measure of the variability of a group of data compared to their average value. Precision is usually stated in terms of relative percent difference (RPD) or relative standard deviation (RSD). Measurement of precision is dependent upon sampling technique and analytical method. Field duplicate and laboratory duplicate samples will be used to measure precision for project samples. Both sampling and analysis will be as consistent as possible. For a pair of measurements, the RPD will be used to evaluate precision. For a series of measurements, RSD will be used to evaluate precision. The total precision of a series of measurements can be related by the additive nature of the variances. Equations for RPD and RSD are presented in Section 13.1 of this SAP.

QC samples, including field and laboratory duplicate samples will be analyzed and used to monitor precision for this project. One field duplicate will be collected for every 20 soil samples. A matrix spike sample and laboratory duplicate sample will be collected at a frequency of one set per 20 samples per matrix. All duplicate results will be evaluated during data validation with respect to the applicable DQO criteria listed in Table 2 and the Region V Standard Operating Procedure for Validation of CLP Inorganic Data (USEPA, 1993).

Precision will be evaluated for all lead analyses performed in this program using the results of field and laboratory duplicate samples.

4.2 ACCURACY

Accuracy is defined as the degree of agreement of a measurement or average of measurements with an accepted reference value. Accuracy measures the bias in a measurement system which may result from sampling or analytical error. Sources of error that may contribute to poor accuracy are:

- laboratory error;
- sampling inconsistency;
- field and/or laboratory contamination;
- sample handling;
- matrix interference; and

- preservation.

Equipment blanks, as well as matrix spike (MS) QC samples, will be used to measure accuracy for project samples. The field component of accuracy will be negligible if the sampling, preservation, and handling techniques described in this SAP are followed. Accuracy in laboratory methods and procedures will be evaluated by use of calibration and calibration verification procedures, and instrument performance solutions, at the frequency specified in the USEPA "Test Methods for Evaluating Solid Waste Physical/Chemical Methods," November 1986, SW-846 3rd edition for lead analyses. Accuracy is calculated using the equation presented in Section 14.2 of this SAP.

Field and laboratory blanks, matrix spike samples and LCSs will be used to measure accuracy for the project samples. Blanks will be used to evaluate whether laboratory or field procedures represent a possible source of contamination. Equipment blanks will be collected one per 20 samples. Matrix spike samples and laboratory duplicates will be analyzed at a frequency of one pair per 20 samples. LCSs will be analyzed at a frequency of one per matrix per 20 samples or per laboratory preparation batch, whichever is more frequent. Accuracy will be evaluated based upon blank and spiked sample results with respect to the applicable DQO criteria listed in Table 2 and the Region V Standard Operating Procedure for Validation of CLP Inorganic Data (USEPA, 1993).

The laboratory method and calibration blanks will be required to meet specific criteria for compliance as listed in SW 846 methodology.

In the data validation, all blank samples will be evaluated. The general procedure for assessing blank samples will be as follows:

- Lead results will be reviewed for all blank samples collected outside of HWMUs.

- Antimony, arsenic, cadmium, lead and selenium results will be reviewed for all blank samples collected inside of HWMUs.

- All blank samples for which lead is reported above the MDL will be identified.

- If contaminants are not detected in any of the blank samples, the data will be reported unqualified for blank contamination.

- If contaminants are found in any of the blank samples, the sample concentration(s) will be reported in the data validation narrative and assessed according to the Region V Standard Operating Procedure for Validation of CLP Inorganic Data (USEPA, 1993).

4.3 DATA REPRESENTATIVENESS

Representativeness expresses the degree to which sample data represent the characteristics of the environment from which they are collected. Samples that are considered representative are properly collected to accurately characterize the contamination at a sample location. Therefore, an adequate number of sampling locations have been chosen, and the samples will be collected in a standardized method. Representativeness will be measured by the collection of field duplicates. Comparison of the analytical results from field duplicates will provide a direct measure of individual sample representativeness.

Comparison of the analytical results from field duplicate samples will provide a direct measure of the representativeness of individual sample results. The RPDs of the field duplicate results will be compared to the project-specific DQOs as given in Table 2.

4.4 DATA COMPLETENESS

Completeness is defined as the percentage of data that is judged to be valid to achieve the objectives of the investigation compared to the total amount of data. Data gaps will be continuously addressed when/if they occur by systematic re-sampling, as needed. Deficiencies in the data may be due to sampling techniques, or poor accuracy, precision, and laboratory error. While deficiencies may affect certain aspects of the data, usable data may still be extracted from applicable samples. The level of completeness, with respect to usable data, will be measured during the data assessment process by comparing the total number of data points to the number of data points determined to be usable. A usability criteria of 90 percent has been set for this project. The equation used for completeness is presented in Section 14.3 of this SAP.

4.5 DATA COMPARABILITY

Comparability expresses the confidence with which one data set can be compared with another data set from a different phase or from a different program. Comparability involves a composite of the above parameters as well as design factors such as sampling and analytical protocols. Data comparability will be ensured by control of sample collection methodology, analytical methodology and data reporting.

4.6 SENSITIVITY

Analytical methods have been selected which can provide the DLs (sensitivity), accuracy and precision criteria defined for this project. Soil samples will be prepared according to USEPA's SW846 (USEPA, 1996) method 3050B, while all field and equipment blanks will be prepared according to SW846 3010A, both hot-acid digestion procedures. All samples will be analyzed using USEPA SW-846 Method 6010B (inductively couples plasma [ICP] spectroscopy).

Specific QLs are highly matrix-dependent and may not always be achievable. See Table 1 for parameters to be analyzed and the corresponding methods and DQO QLs.

4.7 PROCEDURES FOR MONITORING PARCC PARAMETERS

PARCC parameters will be monitored through the submission and analyses of various types of field and laboratory QC samples. These will include appropriate equipment blanks, laboratory method blanks, field duplicates, matrix spikes, and instrument performance solutions. See Table 2 for data quality objectives.

The frequency by which the field and laboratory QC samples will be prepared and submitted is specified in Section 6.5 of this SAP.

5.0 SAMPLING TO BE PERFORMED

This section presents the post excavation screening, stockpile sampling and confirmatory sampling and analysis procedures to be performed by the QA Representative during CM implementation.

5.1 FIELD XRF SCREENING

During excavation activities within areas specifically designated for post-excavation confirmatory sampling, a portable, hand held XRF device will be utilized to aid in the vertical delineation, and in some cases horizontal delineation, of contaminated material exceeding the Post Remediation Goals (PRG) for the targeted site contaminants depending on the particular remediation area. Screening will completed by performing randomly within the excavations based on a 10-foot by 10-foot grid.

Confirmatory samples will be collected from 0 to 6 inch depth increment in the non-HWMU areas and from the 0-6 inch and 6 to 12 inch depth increment within the HWMUs. Samples will be placed in plastic bags, homogenized and the screened with the XRF. Five separate readings will be obtained on each sample, the results recorded and then averaged. Twenty percent of the XRF samples will be submitted for laboratory analysis and the results utilized to develop a correction factor for the other XRF results. Laboratory analyses of Site metals shall be performed using EPA Method SW-846 6010B.

5.2 CONFIRMATORY SOIL AND SEDIMENT SAMPLING

Confirmation soil samples in both HWMU excavations and non-HWMU excavations will be consistent with the general protocol established for soil samples. Materials will be homogenized by mixing in the plastic baggies for at least one minute prior to XRF testing samples destined for laboratory analysis shall be placed in a laboratory provided sampling container and sent to an off-site lab for analysis (lead only in non-HWMUs and Sb, As, Cd, Pb and Se in HWMUs). Areas that require additional excavation after the initial confirmation samples have been collected will be identified with the excavation depth. The results of all soil samples, including the XRF sampling results, XRF correlation samples, confirmation samples and duplicates will be entered into a computerized database.

The post-excavation confirmatory sampling program will be implemented by the QA Representative in areas to demonstrate attainment with the appropriate cleanup goals. A typical description of the XRF analysis is provided, but the actual XRF manufacturer instructions should be followed when performing the analysis.

5.3 STOCKPILE SAMPLING

During the course of the work, the Contractor will generate materials that may be clean relative to the remediation standards being applied to the project and suitable for reuse during restoration. The types of material will be primarily topsoil (stripped during construction of the containment cell and SWM basin), crushed concrete and masonry (resulting from demolition of remnant slabs, concrete pavements, structures and foundations). The work may also generate material suitable for use and structural soil fill or cap soil fill (Specification Section 02210) that the Contractor wishes to have sampled for use as "unrestricted" material. All such materials shall be segregated based on type in stockpiles not exceeding 500 cy and characterized. Stockpile characterization shall be performed using composite samples. Stockpile sampling shall be performed as described in Section 6.2.

5.4 AIR MONITORING

Air quality on-site sampling and personnel sampling will be conducted by the Contractor and monitored by the QA Representative. This SAP is not intended to cover air monitoring.

6.0 SAMPLE COLLECTION PROCEDURES

6.1 CONFIRMATORY SAMPLE COLLECTION

Prior to sampling, loose soil or debris will be removed from the area using a stainless steel spoon or shovel or disposable scoops. Sampling implements will include stainless steel trowels or disposable plastic scoops, hand augering devices, and plastic Zip-Lock® baggies. Field personnel will don a new, clean pair of disposable gloves prior to sampling at each location. All implements, if not disposable, shall be decontaminated between the collection of each sample using the protocol described in this SAP. During the collection of each sample, the physical characteristics of the soil materials shall be recorded. Samples will be thoroughly mixed in a plastic bag for at least one minute. The plastic bag containing homogenized sample will be labeled and entered on the Chain of Custody. Each soil sample will be of sufficient volume for subsequent analytical testing requirements.

Field personnel will record the soil's physical characteristics, a description of the sample location and depth, the time period for each sample collection, surface conditions surrounding the sample location, and all pertinent meteorological information.

6.2 STOCKPILE SAMPLING

Material stockpiles shall be characterized utilizing composite soil samples. The number of composite samples required to characterize a stockpile will be dictated by the estimated size of the pile. Each composite sample shall be comprised of 4 aliquots collected at various locations around the pile.

A detailed description of the sampling procedures is as follows:

A. Estimate the volume of the stockpile. The number of composite samples required is dictated by the estimated volume, as follows:

<250 cubic yards	-	1 Composite Sample
250 to 500 cubic yards	-	2 Composite Samples

B. Divide the stockpile into sections of equal volume based on the number of composite samples required. (i.e. piles <250 cy are treated as a single volume, a pile requiring 2 composite sample is divided in half). One composite sample will be collected from each section.

C. Provide each stockpile with a distinct identification and record the information (including type of material and source area) in the field book.

D. Evaluate the piles for consistency in the visual appearance (color, gradation, etc.) of the materials. Record any notable observations in the field book.

E. Subdivide each section into four quarters of roughly equal volume.

F. For piles that are determined to be relatively consistent (i.e. homogeneous) in visual appearance, collect 1 subsample (aliquot) from each quarter, biasing one sample towards the lower third of the pile, biasing another sample towards the upper third and collecting the remaining two samples from the middle third. In piles that are observed to be heterogeneous, utilize the quartering to dictate the distribution of subsamples around the pile but also target sampling to provide a proportional representation of the various materials in the pile. Collect all subsamples from a depth of greater than one foot below the pile surface.

G. Each aliquot in a stockpile shall have approximately equal volumes and shall be collected into a disposable aluminum tray. Remove large stones, sticks and vegetation. When sampling concrete rubble, the sampler should attempt to get a representative amount of the fines contained in the material after the crushing process and should remove those pieces larger than 1.5 inches.

H. Homogenize the sample by mixing in the aluminum tray until the composite is visually uniform using a disposable scoop and/or gloved hand.

I. Transfer an adequate volume of the composite sample to a glass or other approved sample container. Cap and label the container, wipe residual from the outside of the container and complete require chain of custody. Collect duplicate and MS/MSD samples, as required below. Discard the remaining volume of material onto the stockpile.

J. Decontaminate reusable sample equipment following the procedures described below.

K. Place a stake marked with the stockpile identification and date sampled in the pile. Inform the Contractor when sample results are received and the final designation/disposition of the pile.

6.3 SOIL SAMPLING DECONTAMINATION

The sampling methods prescribed herein have been developed to minimize the possibility of cross-contamination. Those sampling implements which cannot be decontaminated effectively shall be disposed of between and after sample collection. Decontamination procedures for sampling equipment will be as follows:

- Remove particulate matter and surface films with tap water, Alconox and brush as necessary;
- Deionized water rinse;
- Nitric acid rinse (0.1 N);
- Deionized water rinse;
- Air dry (if possible); and

- Cover with plastic or wrap in aluminum foil if stored overnight.

Equipment blanks will be collected for decontamination QC. A description of the types and frequency of QC samples is included in Section 6.6. Any deviations from these procedures will be documented in the field logbook.

All derived wastes from each sampling event will be returned to the ground in the direct vicinity of the sample collection point.

6.4 FIELD SAMPLING DOCUMENTATION PROCEDURES

Field sampling operations and procedures will be documented by on-site personnel in bound field logbooks. Where appropriate, field operations and procedures will be photographed. Documentation of sampling operations and procedures will include documenting:

- Procedures for preparation of reagents or supplies which become an integral part of the sample (e.g., preservatives and absorbing reagents);
- Procedures for recording the exact location and specific considerations associated with sampling acquisition;
- Specific sample preservation method;
- Calibration of field instruments;
- Submission of field-based blanks, where appropriate;
- Potential interferences present at the Site;
- Field sampling equipment and containers including specific identification numbers of equipment;
- Sampling order;
- Decontamination procedures; and
- Field personnel.

Field logbooks will be waterproof and bound. The logbook will be dedicated to the job. No pages will be removed. Corrections will be made by drawing a single line through the incorrect data and initialing and dating the correction that was made to the side of the error. An initialed diagonal line will be used to indicate the end of an entry or the end of the day's activities.

6.5 SAMPLE CONTAINERS AND PRESERVATION

Table 3 lists the appropriated sample containers, preservation methods, and holding times for sample analysis. Samples will be labeled in the field according to the procedures outlined in Section 7.0 of this Attachment.

6.6 QUALITY CONTROL SAMPLES

Field QA/QC samples will be collected to determine if contamination of samples has occurred in the field and, if possible, to quantify the extent of contamination so that data are not lost. Duplicate samples, equipment blanks and matrix spike/matrix spike duplicate (MS/MSD) samples will be collected. The duplicate QC samples will be labeled with distinct identification locations and times, and submitted to the laboratory as regular samples. The actual identification of the duplicate QC samples will be recorded in the field logbook.

A summary of the field QA/QC samples to be collected during the sampling program are presented as follows:

- Equipment blanks consisting of laboratory supplied deionized water poured over sampling equipment;
- Duplicate samples for the soil samples sent for laboratory analysis; and,
- Matrix spike.

6.6.1 Duplicate Samples

Duplicate samples are independent samples collected in such a manner that they are equally representative of the sampling point and parameters of interest at a given point in space and time. Field duplicate samples provide precision information of homogeneity, handling, shipping, storage, preparation and analysis.

Soil sample duplicates will be collected and homogenized before being split. Field duplicate samples will be analyzed with the original field samples for the same parameters. One of every twenty samples submitted for laboratory analysis will be duplicated.

6.6.2 Equipment Blanks

The equipment (rinsate) blank is designed to address cross-contamination between sample sources in the field due to deficient field equipment decontamination procedures. This blank also addresses field preservation procedures, environmental Site interference and the integrity of the source water for field cleaning.

An equipment blank will be prepared during soil sampling when a particular piece of sampling equipment was employed for sample collection and subsequently decontaminated in the field for use in additional sampling. The equipment blank will be composed in the field by collecting, in the appropriate container for water, a blank water rinse from the equipment (spoon, auger, corer, etc.) after execution of the last step of the proper field decontamination protocol. Preservatives or additives will be added to the equipment blank where appropriate for the sampling parameters. One equipment blank will be collected per 20 soil samples collected and sent to the off-site lab for lead analysis.

6.6.3 Matrix Spike Samples

Where required by the SAP, an Matrix Spike/Matrix Spike Duplicate (MS/MSD) will be collected and analyzed for the same parameters as the parent sample. To ensure sufficient sample volume, MS/MSD sample locations shall have a second soil volume collected from the same diameter and depth interval as the parent sample immediately adjacent to the parent sample location. Both soil volumes will be placed into the same baggies, composited together and analyzed with the XRF before being placed in the laboratory supplied sample jars. Each sample will be labeled with the sample number as the parent sample, designated as an MS/MSD sample, and submitted to the laboratory for the appropriate analyses. MS and MSD samples determine accuracy by the recovery rates of the compounds added by the laboratory (the MS/MSD compounds are defined in the analytical methods). The MS samples also monitor any possible matrix effects specific to samples collected from the Site and the extraction/digestion efficiency. In addition, the analysis of MS/MSD samples check precision by comparison of the two spike recoveries. One MS/MSD sample will be collected for every 20 investigative and duplicate soil samples collected and sent to the off-site lab for analysis.

7.0 SAMPLE CUSTODY

Sample identification and chain-of-custody shall be maintained for the work through the following chain-of-custody procedures and documentation:

- Sample labels, which prevent misidentification of samples;
- Custody seals to preserve the integrity of the sample from the time it is collected until it is opened in the laboratory;
- Field logbooks to record information about the site investigation and sample collection;
- Chain-of-Custody records to establish the documentation necessary to trace sample possession from the time of collection to laboratory analysis; and,
- Laboratory logbooks and analysis notebooks, which are maintained at the laboratory to record all pertinent information about the sample.

The purpose of these procedures is to ensure that the quality of the sample is maintained during its collection, transportation, storage and analysis. All chain-of-custody requirements shall comply with standard operating procedures indicated in the EPA sample handling protocol. All sample control and chain-of-custody procedures applicable to the subcontracted laboratory will be presented in the laboratory's procedures.

7.1 CHAIN-OF-CUSTODY

A sample is in custody if it is in someone's physical possession or view, locked up or kept in a secure area that is restricted to authorized personnel.

7.1.1 Field Custody Procedures

As few persons as possible should handle samples in the field. The sample collector is personally responsible for the care and custody of samples collected until they are transferred to another person. The QA Representative will determine whether proper custody procedures were followed during field work and decide if additional samples are required.

7.1.2 Sample Labels

Identification labels are to be attached to the field sample containers. The labels shall not obscure any QA/QC lot numbers on the bottles. Sample information will be printed on the label in a legible manner using waterproof ink. The identification on the label must be sufficient to enable cross-reference with the logbook.

7.1.3 Chain-of-Custody

The chain-of-custody record must be completed by the person responsible for sample shipment to the subcontracting laboratory. All constraints on time and analytical procedures should be marked on the record. The custody record should also indicate any special preservation or filtering techniques required by the laboratory.

7.1.4 Transfer of Custody and Shipment

Chain-of-Custody records must be kept with the samples at all times. When transferring the samples, the parties relinquishing and receiving them must sign, date, and note the time on the record. Each shipment of samples to the laboratory must have its own chain-of-custody record with the contents of the shipment, method of shipment, name of courier, and other pertinent information written on the record. The original record accompanies the shipment and the copies are distributed to the Project Manager. Freight bills, Postal Service receipts and bills of lading are retained as permanent documentation.

7.1.5 Custody Seals

Custody seals are adhesive-backed seals with security slots designed to break if the seals are disturbed. Seals are placed on all shipping containers, and seals shall be signed and dated before use.

7.2 SAMPLE DESIGNATION

Samples collected from each location, shall be identified by using a standard label which is attached to the sample container. The following information shall be included on the sample label:

Site name;
Date and time of sample collections;
Designation of the sample (i.e., grab or composite);
Type of sample with brief description of sampling location (depth);
Signature of sampler;
Sample preservative used; and
General types of analyses to be conducted.

7.2.1 Proposed Sample Identification System

The following sample identification system will be utilized to identify the location, type and depth of each soil sample collected. The removal area identification will match the designations shown on the design drawings and the grid location will utilize an alpha-numeric designation developed by the QA Representative in consultation with the Contractor. Addition information will include depth of sample relative to pre-remediation ground surface.

Type of Sample	Excavation ID/Depth/Date
XRF Field Screening/Confirmation	XRF-FL4B/1.0-1.5-A5
Lab Analysis Confirmation	FL4B/1.0-1.5/A5
Duplicate	FL4B-D/1.0-1.5/A5
Stockpile Composite Sample	SP-1

The results of all soil samples, including the XRF sampling results, XRF correlation samples, confirmation samples and duplicates will be entered into a computerized database. The database will be divided into sections labeled with each individual excavation identification and grid number and sub grid number.

7.3 SAMPLE HANDLING, PACKAGING, AND SHIPPING

Regulations for packaging, marking, labeling, and shipping hazardous materials are promulgated by the USDOT in the Code of Federal Regulations, 49 CFR 171 through 177. Samples obtained from the Site are anticipated to be environmental samples which are not expected to contain high levels of hazardous substances. Therefore, the shipment of samples designated as environmental samples are not regulated by DOT.

Samples collected by the QA Representative will be relinquished, directly to the laboratory, to the laboratory courier or shipped to the laboratories using the method described below. Environmental samples shall be packed prior to shipment by air using the following procedures:

Select a sturdy cooler in good repair. Secure and tape the drain plug with fiber or duct tape.

Allow sufficient outage (ullage) in all bottles to compensate for any pressure and temperature changes (approximately 10 percent of the volume of the container).

Be sure the lids on all bottles are tight (will not leak), and baggies are sealed.

Line coolers with minimum of two large trash bags. Place samples inside of lined coolers. Put ice on top of or between the samples. Pack samples securely to eliminate breakage during shipment. Tie off trash bags to seal.

Place chain-of-custody into a plastic bag, tape the bag to the inner side of the cooler lid and then close the cooler and securely tape (preferably with fiber tape) the top of the cooler shut. Custody seals should be affixed to the top and side of the cooler so that the cooler cannot be opened without breaking the seal.

A label containing the name and address of the shipper shall be placed on the outside of the container.

7.4 SAMPLE PRESERVATION AND HOLDING TIMES

When needed, sample containers will be obtained from the subcontracting laboratory and shall be prepared with a predetermined amount of preservative for each specified sample unless otherwise stated in the site specific field plan. A list of preservatives and holding times for each type of analysis are included Table 3 of this Attachment. Additional preservation requirements and holding times for other analytical parameters are listed, in 40 CFR, Part 136, July 1, 1987.

7.5 LABORATORY SAMPLE CUSTODY PROCEDURES

Once the sample arrives at the laboratory, custody of the samples will be maintained by laboratory personnel. Upon receipt of the samples, the sample receipt personnel will remove the chain-of-custody from the sealed cooler and sign and record the date and time on the chain-of-custody. The samples received will be verified to match those listed on the chain-of-custody. The laboratory will document and notify the sample generators QA Manager immediately if any inconsistencies exist in the paperwork associated with the samples. The laboratory at a minimum will document the following stages of analysis: sample receipt, sample extraction/preparation, sample analysis, data reduction, and data reporting.

Samples will be given a unique laboratory identification number and logged into the Laboratory Information Management System (LIMS). The analyst will enter the analytical data into the LIMS upon analysis completion and validation. The LIMS tracks the sample until completion of the report and invoice mailing. The data archived from the LIMS will be transferred to electronic storage format and retained for five years from the completion of sample analysis.

8.0 CALIBRATION PROCEDURES AND FREQUENCY

All instruments and equipment used during sampling and analysis will be operated, calibrated, and maintained according to the manufacturer's guidelines and recommendations. Operation, calibration and maintenance will be performed by trained personnel on a daily basis. All maintenance and calibration information will be documented and will be available upon request.

9.0 LABORATORY QUALITY ASSURANCE PROGRAM

The quality assurance program for the selected analytical laboratory will be submitted following laboratory selection. The quality assurance program documents are anticipated to include the following:

- Title page;
- Table of contents;
- QA policy statement;
- Laboratory organization and responsibility;
- Sampling procedures and equipment;
- Sample custody;
- Data reduction, validation, and reporting;
- Performance and systems audit;
- Preventive maintenance;
- Corrective action; and
- Resumes.

10.0 DATA REDUCTION VALIDATION AND REPORTING

10.1 DATA REDUCTION

All analytical data will be permanent, complete and retrievable. The analyst will enter the analytical data into the LIMS upon analysis completion and laboratory validation. The laboratory will report sample results on analysis report forms and provide the information referenced in the USEPA Methods for each deliverables package. All laboratory data will undergo the data validation procedures described in the Laboratory QA Manual prior to final reporting. Data will be stored on the laboratory's network until the investigation is complete and data archived from the LIMS will be transferred to magnetic tape which will be retained by the laboratory for an additional five years.

Results will be reported in micrograms per liter (ug/l) for aqueous samples or milligrams per kilogram (mg/kg) for solid samples. Equations to calculate concentrations are found in the SW-846 Method 6010B. All blank results and QC data will be included in the data deliverables package. Blank results will not be subtracted from the sample results. The blank results and QC data will be used in data validation to review sample results qualitatively. Data validation will be performed for soil samples analyzed at the off-site laboratory in general accordance with the guidelines identified in Section 10.2. Outliers and other questionable data will be addressed in the data validation report and specific QA/QC flags will be applied to questionable data. The QA/QC flags will be consistent with the USEPA data validation guidelines.

All analytical data, reports, and any other project related information produced during this project will be stored in the project file at the sample generators office maintained by the Project Manager. Project reports, tables, etc. will be stored in project specific electronic files.

10.2 DATA VALIDATION PROTOCOL

Validation of analytical soil data as received from the off-site laboratory will be performed by an AGC QA Scientist. Validation will be performed in general accordance with the following data validation guidance documents, where applicable:

- National Functional Guidelines for Inorganic Data Review, Multi-Media, Multi-Concentration. USEPA, February 1994.

- Region V Standard Operating Procedures for Validation of CLP Inorganic Data, USEPA, September 1993.

Specifically the information examined will consist of sample results, analytical holding times, sample preservation, chains-of-custody, initial and continuing calibrations, field and laboratory blank analysis results, instrument performance check sample results, MS/MSD recoveries and RPD and field duplicate recoveries. If the criteria listed in the analytical method are not met for any parameter the associated samples will be flagged as described in the referenced validation guidelines. During data validation, data is also reviewed for transcription, calculation, and reporting errors. Calculations for obtaining concentration data for all parameters may be found in the referenced methods.

The purpose of data validation is to verify and retrace the path of the sample from the time of receipt for analysis to the time the final data package report is generated. Upon completion of data validation, the existing results will be reported in tabular form with data validation flags applied as appropriate to determine the usefulness of the data. The data validation flags will be consistent with the USEPA data validation guidelines. A data validation report will be written to assist the Project Manager in making decisions based on the analytical results.

10.3 DATA VALIDATION REPORTS

Data validation reports, along with copies of all support documentation, validated data summary tables, and analytical data packages, will be submitted periodically as data are validated.

10.4 DATA REPORTING

All data deliverables from each laboratory must be paginated in ascending order. The laboratory must keep a copy of the paginated package in order to be able to respond efficiently to data validation inquiries. Any errors in reporting identified during the data validation process must be corrected by the laboratory as requested. All data validation inquiries to the laboratory must be addressed by a written response from the laboratory in question. The data deliverable required for this project will include a case narrative, the sample results (Form 1s), blank data, MS/MSD percent recoveries and relative percent differences, laboratory control sample percent recoveries, and any other quality control data.

11.0 INTERNAL LABORATORY QUALITY CONTROL CHECK SAMPLES AND CALCULATIONS

All QC procedures employed by the laboratory will be, at a minimum, equivalent to those required in the specified analytical methods. Laboratory QC checks are accomplished through the analyses of laboratory blanks, calibration verifications, laboratory control standards and performance evaluation samples. When internal QC results fall outside method acceptance criteria, the data will be reported, and the analysis repeated, flagged or accepted according to the specified analytical methods. The following sections describe internal laboratory QC check samples.

11.1 LABORATORY BLANKS

Method blanks are generated within the laboratory during the processing of the actual samples. These blanks will be prepared using the same reagents and procedures and at the same time as the project samples are being analyzed. If contamination is found in the method blank, it indicates that similar contamination found in associated samples may have been introduced in the laboratory and may not have been actually present in the samples themselves. Guidelines for accepting or rejecting data based on the level of contamination found in the method blank are presented in the specified analytical method.

A minimum of one method blank per 20 samples will be analyzed or, in the event that an analytical round consists of less than 20 samples, one method blank sample will be analyzed per round.

11.2 MATRIX SPIKE/MATRIX SPIKE DUPLICATES

MS analyses are performed in association with metal analyses. MS are prepared by placing a known quantity of selected target analytes into a second aliquot of an actual field sample. The spiking occurs prior to sample preparation and analysis. The MS is then processed in a manner identical to the field sample. Recovery of each of the spiked compounds reflects the ability of the laboratory and method to accurately determine the quantity of that analyte in that particular sample.

11.3 LABORATORY CONTROL SAMPLE

The Laboratory Control Sample (LCS) is prepared by the laboratory by adding analytes of known concentrations to solution (DI water for metals analysis) for analyses. The LCS is prepared, analyzed and reported once per sample delivery group (SDG). The LCS must be prepared and analyzed concurrently with the samples in the SDG using the same instrumentation as the samples in the SDG. The LCS is designed to access (on a SDG-by-SDG basis) the capability of the laboratory to perform the analytical methods. If the analytes present in the LCS are not recovered within the criteria defined in the specified analytical methods, the samples will be reanalyzed or data will be flagged.

12.0 PERFORMANCE AND SYSTEM AUDITS

12.1 LABORATORY AUDITS

The purpose of a quality assurance audit is to provide an objective, independent assessment of a measurement effort. The quality assurance audit ensures that the laboratory's data generating, data gathering, and measurement activities produce reliable and valid results. There are two forms of quality assurance audits: performance evaluation audits and system audits.

12.1.1 Performance Evaluation Audits

The purpose of performance evaluation audits is to quantitatively measure the quality of the data. These audits provide a direct evaluation of the various measurement systems' capabilities to generate quality data.

The laboratory regularly participates in performance evaluation audits as part of their laboratory certification efforts. Performance audits are conducted by introducing control samples in addition to those routinely used.

The results of the performance audits are summarized and maintained by the Laboratory QA Supervisor and distributed to the section supervisors who must investigate and respond to any out of control results.

12.1.2 Technical System Audits

A technical systems audit is an on-site, qualitative review of the various aspects of a total sampling and/or analytical system. The purpose of the technical systems audit is to assess the overall effectiveness, through an objective evaluation, of a set of interactive systems with respect to strength, deficiencies, and potential areas of concern. Typically, the audit consists of observations and documentation of all aspects of sample analyses. External and internal audits are conducted of the laboratory throughout each year.

13.0 PREVENTATIVE MAINTENANCE

13.1 FIELD EQUIPMENT

Field measurement equipment and the XRF unit will be maintained in accordance with manufacturer's instructions. All field equipment will be checked by qualified technicians prior to use in the field. The instrument operator will be responsible for ensuring that the equipment is operating properly prior to use in the field. Any problems encountered while operating the instrument will be documented in the field logbook. If problem equipment is detected or should require service, the equipment will be returned and a qualified technician will perform the maintenance required. Use of the instrument will not be resumed until the problem is resolved. Routine maintenance of field instruments will be documented in the field logbooks.

13.2 LABORATORY EQUIPMENT

Preventative maintenance and periodic maintenance is performed as recommended by the manufacturers of the equipment in use in the laboratory. Spare parts are kept in inventory to allow for minor maintenance. Service contracts are maintained for most major instruments, balances and critical equipment. If an instrument fails, the problem will be diagnosed as quickly as possible, and either replacement parts will be ordered or a service call will be placed.

Laboratory logbooks are kept by the laboratory to track the performance maintenance history of all major pieces of equipment. The instrument maintenance logbooks are available for review upon request. Specific details of preventative maintenance programs for the laboratory will be provided in the Laboratory QA Manual.

14.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY AND COMPLETENESS

14.1 PRECISION

The precision of laboratory test results will be expressed as RPD or RSD. RPD is derived from the absolute difference between duplicate analyses divided by the mean value of the duplicates. The percent RSD is obtained by dividing the standard deviation by X. Equations for RPD and RSD are presented below:

$$RPD = \frac{|D1 - D2|}{(D1 + D2)/2} \times 100$$

Where:

D1 and D2 = the two replicate values

$$RSD = \frac{S}{X}; \text{ and } S = [n\,(x_i - x)^2/n-1]^{1/2}$$

i-1

Where:

S	=	standard deviation
x_i	=	each observed value
x	=	the arithmetic mean of all observed values
n	=	total number of values

14.2 ACCURACY

Accuracy will be calculated on the average percent recovery of spiked samples. Reference materials are essential to the evaluation of accuracy. Stock solutions for accuracy spikes and QC standards (if possible) shall be traceable to a source independent from the calibration standards. Accuracy is calculated using the following equation:

$$\%R = \frac{SSR - SR}{SA} = 100$$

Where:

%R	=	% recovery
SSR	=	spike sample result
SR	=	sample result
SA	=	amount of spike

14.3 DATA COMPLETENESS

Completeness is evaluated by dividing the total number of verifiable data points by the maximum number of data points possible and expressing the ratio as a percent. A usability criteria of 90 percent has been set for this project. The equation used for completeness is presented below:

$$C(\%) = \frac{D}{P \times n} \times 100$$

Where:

D	=	number of confident quantifications
P	=	number of analytical parameters per sample requested for analysis
n	=	number of samples requested for analysis

15.0 CORRECTIVE ACTION

When field sampling activities or laboratory QC results show the need for corrective action, immediate action will take place and will be properly documented. In the event that a problem arises, corrective action will be implemented. Any error or problem will be corrected by an appropriate action which may include:

- Replacing or repairing a faulty measurement system;
- Discarding erroneous data;
- Collecting new data; and
- Accepting the data and acknowledging a level of uncertainty.

15.1 FIELD SAMPLING CORRECTIVE ACTION

The on-site Principle Investigator will be responsible for all field QA. Any out of protocol occurrence discovered during field sampling will be documented in the field logbook and immediate corrective action will be taken. For problems or situations which cannot be solved through immediate corrective action, the Principle Investigator will immediately notify the AGC Project Manager. The AGC Project Manager and Principle Investigator will investigate the situation and determine who will be responsible for implementing the corrective action. Corrective action will be implemented upon approval by the AGC Project Manager. The Project Manager will verify that the corrective action has been taken, appears effective, and at a later date, verify that the problem has been resolved. The successfully implemented corrective action will be documented in the field logbook by the on-site Principle Investigator. Any deviations from the QA protocol in the SAP must be justified, approved by the AGC Project Manager (and IDEM and the USEPA, if necessary), and properly documented.

15.2 LABORATORY SITUATION CORRECTIVE ACTION

Corrective action will be implemented to correct discrepancies found which affect the validity or quality of analytical data, and to identify any analytical data that may have been affected. Limits of data acceptability for each parameter and sample matrix are addressed in the instrument manuals, USEPA Methods and/or Laboratory QA Manual. Whenever possible, immediate corrective action procedures will be employed. All analyst corrective actions are to be followed according to the instrument manuals, USEPA Methods, or Laboratory QA Manual. Any corrective action performed by the analyst will be noted in laboratory logbooks.

Laboratory personnel noting a situation or problem which cannot be solved through immediate corrective action will notify the Laboratory QA Supervisor. The QA Supervisor will investigate the extent of the problem and its effect on the analytical data generated while the deficiency existed. All data suspected of being affected will be scrutinized to determine the impact of the problem on the quality of the data. If it is determined that the deficiency had no impact on the data, this finding will be documented. If the quality of the analytical data were affected, the Laboratory Program Manager and the sample generator's Project Manager will be notified immediately so that courses of action may be identified to determine how to rectify the situation.

The laboratory must take corrective action if any of the QC data generated during the laboratory analyses are outside of the method criteria. Corrective action for out-of-control calibrations is to recalibrate the instrument and re-analyze the samples. A sequence is specified in the USEPA specified methods when problems in analyses are encountered. The laboratory will follow these procedures exactly and document the problems encountered and the corrective action in a case narrative enclosed with each data deliverables package.

The Laboratory QA Supervisor will be responsible for informing the Laboratory Program Manager and sample generator's Project Manager of the effects on the data, the data affected and the corrective action taken. It is also the Laboratory QA Supervisor's responsibility to verify that the corrective action was performed, appears effective, and at a later date, the problem was resolved.

15.3 DATA VALIDATION QA CORRECTIVE ACTION

Upon completion, sample data packages will be sent from the laboratory to the sample generator's QA Scientist for data validation. If all project samples are not present in the data packages or any deficiencies affecting the sample results are noted, the QA Scientist will contact the Laboratory QA Supervisor. The Laboratory QA Supervisor will respond in writing to any inquiries and provide any changes to the data packages to the QA Scientist. Any errors, problems, questionable data values, or data values outside of established control limits will be corrected by the appropriate action which may include disregarding erroneous data, collecting new data, and accepting the data and acknowledging a level of uncertainty. The data validation report will provide a description of the usability of the data.

TABLES

TABLES

TABLE 1
SAMPLING PARAMETERS AND REPORTING LIMITS
RMC Beechgrove, Indiana

LOCATION	MATRIX	METHOD	PARAMETER	RL	DQO	UNITS
HWMU	Soil/Sediment	SW-846 6020[1]	Antimony	1	37	mg/kg
		SW-846 6010B[1]	Arsenic	10	20	mg/kg
			Cadmium	1	77	mg/kg
			Lead	5	970	mg/kg
			Selenium	10	53	mg/kg
outside HWMU, but still onsite		SW-846 6010B[1]	Lead	5	920	mg/kg
Offsite		SW-846 6010B[1]	Lead	5	400	mg/kg
Equipment Blanks	Aqueous	SW-846 6020[1]	Total Antimony	10	N/A	µg/L
		SW-846 6010B[1]	Total Arsenic	100	N/A	µg/L
			Total Cadmium	10	N/A	µg/L
			Total Lead	50	N/A	µg/L
			Total Selenium	100	N/A	µg/L

Notes:
Antimony will be analyzed by SW-846 6020A
µg/L: micrograms per liter RL: Reporting Limit
mg/L: milligrams per liter DQO: Data Quality Objective
mg/kg: milligrams per kilogran N/A: not applicable

[1]USEPA "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", Feb. 2007, SW-846, 6th Revision.

TABLE 2
DATA QUALITY OBJECTIVES
RMC Beechgrove, Indiana

DQO PARAMETER	LABORATORY PARAMETERS (aqueous)	LABORATORY PARAMETERS (soil/sediment)
PRECISION		
Matrix Spike	<20% RPD for results > 5*RL <±RL for results < 5*RL	<35% RPD for results > 5*RL <±2*RL for results < 5*RL
Field Duplicate	<30% RPD for results > 5*RL <±RL for results < 5*RL	<50% RPD for results > 5*RL <±2*RL for results < 5*RL
ACCURACY		
Laboratory Blank	<RL	<RL
Equipment Blank	<RL	<RL
Matrix Spike	80-120 %R unless sample concentration exceeds the spike added by a factor of 4 or more.	75-125 %R unless sample concentration exceeds the spike added by a factor of 4 or more.
Laboratory Control Sample	80-120 %R	80-120 %R
COMPLETENESS	90%	90%
COMPARABILITY	Based on precision, accuracy and media comparison	Based on precision, accuracy and media comparison

RPD: Relative percent difference.
RL: Reporting limit
%R: Percent recovery.

TABLE 3
SAMPLE CONTAINERS, PRESERVATIVES, AND HOLDING TIMES
RMC Beechgrove, Indiana

LOCATION	MATRIX	METHOD	PARAMETER	CONTAINER	PRESERVATIVE	HOLDING TIME
HWMU Areas	Soil/Sediment	SW-846 6010B[1]	Antimony, Arsenic, Cadmium, Lead, Selenium	zip lock baggies	none	6 months
Non-HWMU Onsite Areas	Soil/Sediment	SW-846 6010B[1]	Lead	zip lock baggies	none	6 months
Offsite Areas	Soil/Sediment	SW-846 6010B[1]	Lead	zip lock baggies	none	6 months
Equipment Blanks	Aqueous	SW-846 6010B[1]	Antimony, Arsenic, Cadmium, Lead, Selenium	1 L plastic	HNO_3 pH<2; cool 4° C	6 months

[1]USEPA "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", Feb. 2007, SW-846, 6th Revision.

ATTACHMENT E

Operation and Maintenance Plan

ATTACHMENT E

Operation and Maintenance Plan

OPERATION AND MAINTENANCE PLAN
POST CORRECTIVE MEASURES IMPLEMENTATION
FORMER REFINED METALS CORPORATION FACILITY
BEECH GROVE, INDIANA

Prepared for:

Refined Metals Corporation
Beech Grove, Indiana

Prepared by:

ADVANCED GEOSERVICES CORP.
West Chester, Pennsylvania

Project No. 2003-1046-18
October 6, 2010

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1.0 INTRODUCTION

1.1 PURPOSE

This Operation and Maintenance Plan (O&M Plan) describes the required inspection and maintenance activities for the post-closure period following the completion of corrective measures and Hazardous Waste Management Unit (HWMU) closure at the former Refined Metals Corporation facility situated at 3700 South Arlington Avenue in Beech Grove, Indiana (the Site). This Plan was written in accordance with requirements of Exhibit D "Scope of Work for a Corrective Measures Implementation" Task XIII(B) Operation and Maintenance Plan of the Consent Decree.

This O&M Plan has been prepared in anticipation that corrective measures and closure activities will be completed as described in the Corrective Measures Design, as prepared by Advanced GeoServices Corp.

1.2 SCOPE

The post-closure care operation and maintenance will include activities related to the following Corrective Measures components:

- Containment Cell;
- Groundwater Monitored Natural Attenuation (MNA);
- Storm Water Management; and,
- Institutional Controls and Site Security.

Post-closure care will be enforced for 30 years following closure per 40 CFR 264.117 unless in the opinion of USEPA or IDEM the monitoring period may be shortened or must be extended. Post-closure care will be evaluated periodically to determine if modified post-closure activities are sufficient to protect human health and the environment.

1.3 CONTACT

In accordance with state and federal regulations, the name, address, and phone number of the person or office to contact about the facility during the post-closure period is included. At this time, the information is as follows:

Refined Metals Corporation
c/o Exide Technologies, Inc.
3000 Montrose Avenue
Reading, PA 19605

Attention: Mr. Matthew Love
Director of Global Environmental Affairs
(610) 921-4054

1.4 ORGANIZATION

Pursuant to Exhibit D of the Consent Decree, the remainder of this document includes the following Section:

- Section 2.0 Description of Normal Operation and Maintenance
- Section 3.0 Description of Potential O&M Problems and Corrective Steps
- Section 4.0 Description of Routine Monitoring and Laboratory Testing.
- Section 5.0 Safety Plan

- Section 6.0 Records and Reporting

2.0 NORMAL OPERATION AND MAINTENANCE

2.1 GENERAL

The Corrective Measures Design was prepared with the intent of providing a post-closure condition that functions and remains stable with minimal operation and maintenance requirements. Normal O&M requirements for the site are expected to be limited to periodic inspections and routine maintenance. The observations to be made during the inspections and routine maintenance requirements are as follows.

2.2 VEGETATIVE COVER

The vegetative cover will be inspected quarterly during the first year following completion of CM construction, semi-annually during the second and third years following completion of CM construction and annually thereafter. The inspector will ensure that the vegetative ground cover in the containment cell cap and those areas on-site stabilized with turf are fully established and remain stable. Until establishment of a stabilized vegetative surface the inspector will determine whether additional seeding, mulching, or watering is necessary. The turf and lawn areas of the RMC owned property will be mowed at least annually or as necessary for routine maintenance. The vegetative cover on the cell and in the storm water management basins will be mowed to a typical height of 6 inches to protect the growth of low lying legume grasses. The sod within the right-of-way for South Arlington Avenue and turf along the southern fence line of the Citizens Gas property will be inspected for acceptability of establishment during the first year in conjunction with the quarterly on-site inspections. The property owners will be responsible for routine maintenance mowing; however, RMC will be responsible for addressing property owner concerns regarding adequacy and acceptability of the restoration during the first year following construction. Condition of the vegetative cover observed during the inspections will be recorded in the appropriate sections of the inspection Form.

2.3 CONTAINEMNT CELL CAP STABILITY

The containment cell cap and berm will be visually inspected to ensure the integrity and effectiveness of the final cover and note any repairs necessary to correct the effects of settling, subsidence, sliding, or erosion. The cap will be inspected quarterly during the first year following completion of CM construction, semi-annually during the second and third years following completion of CM construction, and annually thereafter. The visual evaluation of slopes associated with the final grading plan of the Containment Cell will include, but is not limited to, the following observations:

- Areas of ponding or subsidence
- an improperly anchored liner,
- burrowing animals,
- development of woody vegetative growth that may damage geomembrane,
- soil sliding or sloughing, and
- soil tensile cracking.

Condition of the containment cell and berm observed during the inspections will be recorded in the appropriate sections of the inspection Form.

2.4 INSTITUTIONAL CONTROL AND SITE SECURITY

A visual evaluation of the perimeter chain-link fencing will be conducted quarterly during the first year following completion of CM construction, semi-annually during the second and third years following completion of CM construction, and annually thereafter. The inspections will include, but not be limited to, the following:

- Observing the fence for vandalism or damage

- Confirming that gates and locks are operational.
- Evaluating the site for improper use or development, and,
- Presence of required signage.

Condition of the security fence and site observed during the inspections will be recorded in the appropriate sections of the inspection Form.

2.5 STORM WATER SYSTEM

The storm water management systems will be evaluated during inspections and includes verifying that all storm water controls (i.e., channels, storm water basins and outlets) are working properly and are without defect. Inspections will be conducted quarterly during the first year following completion of CM construction, semi-annually during the second and third years following completion of CM construction, and annually thereafter. Channels, storm water basins, and basin outlet structures will be inspected for blockage or clogging from sediment or debris. The inspector will also verify that run-on and run-off are not eroding or damaging the final cover. Condition of the storm water system observed during the inspections will be recorded in the appropriate sections of the inspection Form.

2.6 GROUNDWATER MONITORING

Groundwater monitoring is proposed as a means of evaluating post Corrective Measure groundwater quality in the vicinity of the containment cell (Containment Cell Groundwater Monitoring) and to determine the trends in groundwater quality following completion of the CM implementation (MNA Groundwater Monitoring). Groundwater sampling for both types of groundwater monitoring will be performed quarterly during the first three years following completion of the CM implementation, semi-annually during years 4 and 5 and annually thereafter until RMC can demonstrate to the satisfaction of USEPA that the containment cell is not detrimentally impacting groundwater and that previous groundwater impacts as established as part of the MNA have stabilized. The monitoring and laboratory testing requirements for groundwater are described in Section 4.0 if the O&M Plan.

3.0 POTENTIAL O&M PROBLEMS AND CORRECTIVE STEPS

3.1 VEGETATIVE COVER

Operating problems likely to be documented during the routine inspections may include insufficient germination of turf seeding, dead or dying sod, excessive erosion, insufficient maintenance and/or damage caused by mowing equipment.

3.1.1 Insufficient Germination/Sod Establishment - Insufficient grass seed germination or sod establishment will be observed in the form of bare spots in the soil, spotty germination, stunted grass growth or other conditions lacking lushness or continuity. Causes for such conditions are numerous and the inspector will require the Contractor that performed the seeding and maintenance diagnose and mitigate the problem. Such measures related to seeding may include any combination of over-seeding, additional watering, or supplemental fertilizing. Measures related to sod may include replacing the sod, increasing the frequency of watering (for under-watered conditions) or reducing the amount of watering (for over-watered conditions).

3.1.2 Erosion – Erosion is most likely to occur on those areas that are more steeply sloped and/or in those areas where concentrated surface water flows and is more prominent in areas of poor vegetative growth. Erosion is most likely to occur in the first year following CM implementation, during which time the Contractor will be required to facilitate repairs. After the first year, erosion will usually be the result of an unusually significant precipitation event or surficial disturbance (such as tire rutting). In areas of vegetation, repair is most effectively performed by eliminating or managing the cause of the erosion; backfilling the erosion rills with soil and topsoil, as appropriate; reseeding and installation of erosion control blanket. In areas protected by crushed stoned or crushed concrete, the repair will also require eliminating or managing the cause of the erosion to the extent possible and restoring the crushed stone or concrete. The precise methods will be determined by the inspector based on the actual conditions observed. If erosion has resulted in exposure of contents of the containment cell or damage to the cap geomembrane USEPA shall be notified.

3.1.3 Insufficient Maintenance or Maintenance Related Damage – Insufficient maintenance of the vegetative cover or maintenance related damage will likely be limited to lack of mowing on the containment cell cap, rutting caused by lawn mowing or other vehicular traffic when surface soils are too wet, or damage to established turf by cutting the grass too short. Indications will be obvious at the time of inspection in the form of excessive vegetative growth (especially woody growth), tire ruts, or damage or disturbance of previously established growth. Corrective measures could include arranging to have the unmaintained areas mowed, backfilling and reseeding the areas of ruts, or modifying the mowing techniques and repair areas of excessive damage.

3.2 CONTAINMENT CELL CAP STABILITY

Instability of the containment cell cap would most likely occur in the form of soil creep or interface sliding down the steepest portions of the slope; settlement or subsidence in the flat areas of the cap; and excavations, tunnels or burrows by animal or manmade.

3.2.1 Soil Creep or Interface Sliding – Soil creep occurs when the cover soil is moving down the slope because of insufficient internal shear strength and usually occurs shortly following cap construction or following a period when the cover soil has become saturated. Interface sliding also typically occurs shortly after or during construction and is the result of inadequate interface friction between cap geosynthetic components. If such movement occurs it is most commonly observed in the form of gaping cracks in the cover soil at the top of the slope perpendicular to the slope, and/or as mounding at or near the toe of the slope.

Such movement will require immediate notification to the USEPA and evaluation by a geotechnical engineer to determine the significance of the movement and whether or not repairs are necessary. If repairs are necessary the geotechnical engineer will provide written recommendations for repairs for review and approval by the USEPA.

3.2.2 Settlement or Subsidence – Settlement and subsidence occur when the materials placed in the containment cell and/or the cover soil materials were insufficiently compacted. Settlement and subsidence usually occur locally and are observed as surface irregularities or areas of poor drainage on the flatter portions of the cap. The extent of repairs is a function of the amount of settlement or subsidence. For small areas with limited amounts of settlement or subsidence the corrective measure will be the additional of topsoil to eliminate the low spots and areas of standing water. For large areas of significant settlement, an Engineer shall evaluate the problem area and develop written recommendations.

3.2.3 Excavations, Tunnels and Burrows – Excavations through the cover soil have the potential to damage the geocomposite drainage layer and geomembrane. During inspections, the inspector will look for disturbance of the cap. For tunnels or burrows caused by wildlife the resulting penetration shall be sealed and the area revegetated. For manmade penetrations the inspector shall attempt identify and contact the party responsible for the excavation to determine the reason for the disturbance and the depth. If damage of the geosynthetic components is suspected the liner shall be exposed, evaluated and repaired as appropriate.

3.3 INSTITUTIONAL CONTROLS AND SITE SECURITY

During inspections, the site security fence shall be evaluated for damage and the site property will be evaluated for excavations or other activities that being performed without consideration of institutional controls imposed on the property. If damage to the security fence is observed the resulting damage shall be repaired. If excavations or other activities are indentified they shall be brought to the immediate attention of RMC and as appropriate RMC will notify USEPA.

3.4 STORM WATER SYSTEM

Potential problems with the storm water management system will be erosion of the drainage ditches, clogging of the drainage ditches or storm water management basin outlet structures by accumulated sediment, debris or vegetative growth. If observed, the Inspector will notify RMC who will make arrangements for appropriate maintenance and restoration of operational conditions.

4.0 ROUTINE SAMPLING AND LABORATORY TESTING

4.1 GENERAL

Routine sampling and laboratory testing is limited to groundwater sampling required as part of the Containment Cell Groundwater Monitoring and MNA Groundwater Monitoring.

4.2 CONTAINMENT CELL GROUNDWATER MONITORING

As part of O&M, RMC proposes to collect and analyze samples from seven (7) shallow groundwater monitoring wells proposed to be installed around the containment cell (CC-1 through CC-6) and MW-2. Synoptic water levels will be collected during each sampling event from all Site groundwater monitoring wells at the Site.

Proposed wells CC-1 through CC-6 will be sampled at least once during CM implementation and once per quarter for seven quarters following the completion of CM implementation. Groundwater sampling will be performed semi-annually in the third and fourth years following completion of CM implementation and annually thereafter. Samples will be submitted to Tri-Matrix Laboratories (Grand Rapids, Michigan) and analyzed. Groundwater samples performed for containment cell monitoring will be analyzed for Indicator Parameters and Site Specific Parameters as follows:

Groundwater Indicator Parameters

- Field and Laboratory pH
- Field Specific Conductance
- Total Organic Carbon (TOC)
- Field Turbidity

Site Specific Parameters

- Antimony (filtered and unfiltered)
- Arsenic (filtered and unfiltered
- Lead (filtered and unfiltered)

Sampling equipment and method procedures shall be consistent with the Groundwater Monitoring Plan currently followed for quarterly groundwater sampling performed under IDEM for the lagoon. Analysis for site specific parameters will include filtered and unfiltered samples to allow clarification and understanding of contribution by suspended solids (un-filtered results minus filtered results) versus actual water quality (filtered results).

Analytical data packages will be reviewed and validated by a qualified data validator. An initial report will be provided to USEPA with the subsequent inspection report. In addition, on or before March 1 of every year, the results of the sampling for the previous year will be submitted to IDEM in an Annual Groundwater Report. The results will include a groundwater contour map for depth to water measurements taken at the time of each sampling event, a table of results specific to each sampling event, and a summary table on a well by well basis.

4.3 MNA GROUNDWATER MONITORING

Historic groundwater sampling has identified elevated concentrations of lead and arsenic in shallow perched groundwater in the northwest portions of the former manufacturing area. Under this plan, RMC proposes to collect and analyze samples from thirteen (13) shallow groundwater monitoring wells. Sampling will be performed once per quarter for at least eight quarters. Additional information regarding the MNA activities is provided in Attachment H.

Sampling equipment and method procedures shall be consistent with the Groundwater Monitoring Plan currently followed for quarterly groundwater sampling performed under IDEM for the lagoon. Analysis for site specific parameters will include filtered and unfiltered samples to allow clarification and understanding of contribution by suspended solids (un-filtered results minus filtered results) versus actual water quality (filtered results).

5.0 SAFETY PLAN

The Contractor responsible for conducting inspections and performing groundwater sampling shall maintain and observe a Health and Safety Plan applicable to the proposed O&M activities. Personnel performing the site inspections and sampling shall have current OSHA required Health and Safety Training and medical monitoring.

6.0 RECORDS AND REPORTING

A post-closure inspection form and site map will be completed during all inspections. A written inspection report on the condition of the Site will be submitted to USEPA and IDEM for each inspection.

Analytical data packages will be reviewed and validated by a qualified data validator. An initial report will be provided to USEPA with the subsequent inspection report. In addition, on or before March 1 of every year, the results of the sampling for the previous year will be submitted to the in an Annual Groundwater Report. The results will include a groundwater contour map for depth to water measurements taken at the time of each sampling event, a table of results specific to each sampling event, and a summary table on a well by well basis.

TABLE

TABLE

TABLE 1

POST-CORRECTIVE MEASURES INSPECTION FORM
FORMER REFINED METALS CORPORATION FACILITY
BEECH GROVE, INDIANA

INSPECTOR'S NAME:________________ INSPECTION DATE:________________

INSPECTION ITEM	INSPECTED Y OR N	INSPECTION OBSERVATIONS	MAINTENANCE WORK PERFORMED
1. VEGETATIVE COVER ☐ Adequate Grass Growth			
☐ Additional Seeding or Mulching			
☐ Watering Required			
☐ Grass Length/Mowing			
☐ Other			
2. FINAL COVER CAP INTEGRITY ☐ Settling, Subsidence, Erosion			
☐ Soil Cracking			
☐ Water Ponding			
☐ Leachate Seeps/Odor			
☐ Animal Burrows			
☐ Other			
3. SLOPE STABILITY ☐ Failure/Deterioration			
☐ Erosion/Vegetation			
4. FENCING ☐ Deterioration/Damage			
☐ Signs			
☐ Burrowing Under Fence			
5. STORM WATER SYSTEMS ☐ Blockage/Clogging			
☐ Deterioration/Damage			

TABLE 1

POST-CORRECTIVE MEASURES INSPECTION FORM
FORMER REFINED METALS CORPORATION FACILITY
BEECH GROVE, INDIANA

INSPECTOR'S NAME:__________________ INSPECTION DATE:________________________

INSPECTION ITEM	INSPECTED Y OR N	INSPECTION OBSERVATIONS	MAINTENANCE WORK PERFORMED
1. VEGETATIVE COVER ☐ Adequate Grass Growth			
☐ Additional Seeding or Mulching			
☐ Watering Required			
☐ Grass Length/Mowing			
☐ Other			
2. FINAL COVER CAP INTEGRITY ☐ Settling, Subsidence, Erosion			
☐ Soil Cracking			
☐ Water Ponding			
☐ Leachate Seeps/Odor			
☐ Animal Burrows			
☐ Other			
3. SLOPE STABILITY ☐ Failure/Deterioration			
☐ Erosion/Vegetation			
4. FENCING ☐ Deterioration/Damage			
☐ Signs			
☐ Burrowing Under Fence			
5. STORM WATER SYSTEMS ☐ Blockage/Clogging			
☐ Deterioration/Damage			

ATTACHMENT F

Construction Cost Estimate

ATTACHMENT F

Construction Cost Estimate

FINAL C[illegible]STIMATE
(Revised October 2010)

Pay Item	Pay Unit	Cost	Number/Size of Items	Extended Cost
Site Preparation	Lump Sum	$50,000		$50,000
Clearing and Grubbing	Lump Sum	$20,000		$20,000
Unreinforced Silt Fence	Lineal Foot	$4.10/ft.	2,000 ft.	$8,200
Construction Entrance	Each	$4,000 each	2	$8,000
Decontamination Pad	Each	$6,000 each	2	$12,000
Haul Road	Lineal Foot	$20/ft.	350 ft.	$7,000
Pumphouse Demolition	Each	$1,500 each	4	$6,000
Loading Dock Demolition	Lump Sum	$5,000		$5,000
Concrete and Asphalt Pavement Demolition	Lump Sum	$12,000		$12,000
Water Treatment	Lump Sum	$40,000		$40,000
Removal/Handling/Placement Soils and Sediment	Cubic Yard	$7/cy.	12,848 cy.	$89,936
Structural Soil Fill	Cubic Yard	$9.20/cy.	10,000 cy.	$92,000
General Soil Fill	Cubic Yard	$7/cy.	500 cy.	$3,500
Granular Fill	Square Yard	$6/sy.	24,457 sy.	$146,742
Cap Soil Fill	Square Yard	$12/sy.	7,000 sy.	$84,000
60 mil. Textured HDPE	Square Yard	$11.50/sy.	7,000 sy.	$80,500
Composite Drainage Layer	Square Yard	$4.85/sy.	7,000 sy.	$33,950
Edge Drain	Lineal Foot	$15/ft.	1,060 ft.	$15,900
Topsoil (cap)	Square Yard	$6.31/sy.	7,000 sy.	$44,170
Turf Reinforcement	Square Yard	$3.50/sy.	9,080 sy.	$31,780
Turf Reinforcement (Net Free)	Square Yard	$9.00/sy.	15,125 sy.	$22,688
Seeding, Mulching, Fertilizing	Acre	$2033/acre	5 acres	$10,165
Sod Installation (includes topsoil)	Square Yard	$9/sy.	4622 sy.	$41,598
Stone Drainage Ditches	Lineal Foot	$25/ft.	1951 ft.	$48,775
Security Fence	Lineal Foot	$26/ft.	375 ft.	$9,750
15" Dia. RCP	Lineal Foot	$45/ft.	50 ft.	$2,250
12" Dia. RCP	Lineal Foot	$35/ft.	50 ft.	$1,750
Concrete Headwalls	Each	$1,200 each	4	$4,800
Air Monitoring Station	Each	$3,000 each	3	$9,000
High Volume Samples	Each	$50 each	250	$12,500

Total =	$953,954
Construction QA (20%) =	$190,791
Completion Certification =	$15,000
Final Cost =	$1,159,744

ATTACHMENT G

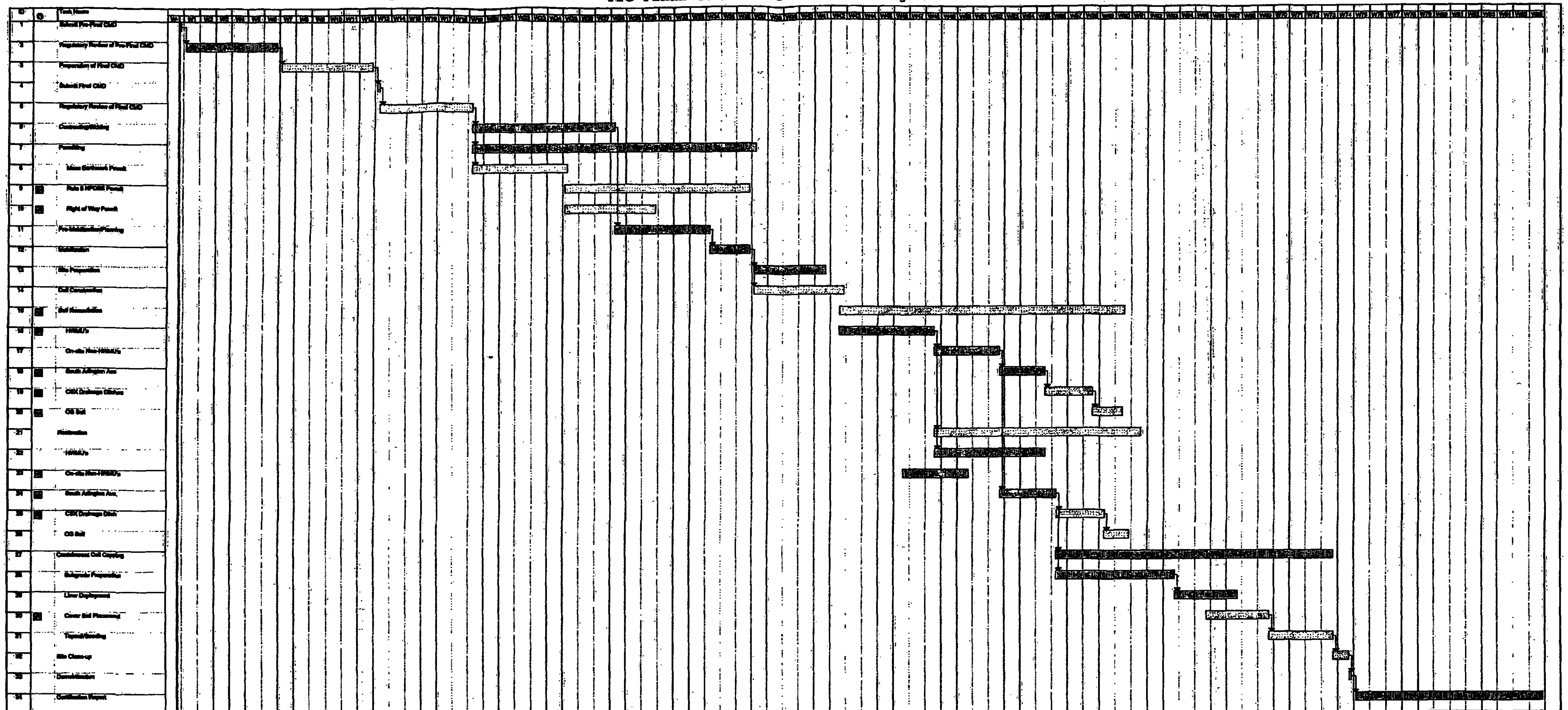
Tentative Construction Schedule

ATTACHMENT G

Tentative Construction Schedule

RMC Beech Grove

Pre-Final Corrective Measures Project Schedule



NOTES

1. The schedule shown does not account for Saturdays and Sundays as working days.
2. A 30-day regulatory review of the Pre-final CMD is assumed within the schedule.
3. A 30-day regulatory review of the Final CMD is assumed within the schedule.
4. A total of 90 days is assumed for receipt of Mass Earthwork, Rule 5 NPDES and Right-of-Way permits.
5. The schedule assumes a 45-day period for contracting/bidding negotiations.
6. The schedule allows for commencement of restoration activities upon completion of remediation activities within an area.
7. The schedule allows for commencement of containment cell capping activities upon completion of restoration activities within an area.

ATTACHMENT H

Monitored Natural Attenuation Work Plan

MONITORED NATURAL ATTENUATION WORK PLAN

Prepared For:

REFINED METALS CORPORATION
Beech Grove, Indiana

Prepared By:

ADVANCED GEOSERVICES
West Chester, Pennsylvania

Project No. 2003-1046-18
October 6, 2010

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LIST OF APPENDICES

1.0 PURPOSE

This Monitored Natural Attenuation Work Plan (MNA Work Plan) is intended to present a description of the Hydrogeologic Conceptual Site Model; a summation of sampling results for the shallow perched groundwater zone as observed during the RCRA Facility Investigation (RFI) and Closure Investigation; proposed MNA data collection requirements; and procedures for MNA data evaluation and reporting at the former Refined Metals Corporation (RMC) facility located on South Arlington Avenue in Beech Grove, Indiana. This MNA Work Plan is intended to provide supplemental information specific to groundwater as an Attachment to the Corrective Measures Design (CMD) Report.

As discussed in Section 5.0 of the CMD Report and specified in the Media Cleanup Standards section of the Statement of Basis (USEPA, June 2008), the corrective measure for the RMC facility will involve the excavation of soil and sediment with the highest lead and arsenic concentrations and consolidation within a containment cell with a low-permeability cover, and MNA of shallow perched groundwater. The proposed soil and sediment excavation activities being performed as part of the Corrective Measures will involve the removal of approximately 6,000 cubic yards of on-site material and achieve a Preliminary Remediation Goal for lead of 920 mg/kg. As part of the Hazardous Waste Management Unit (HWMU) Closure, nearly 5,000 cubic yards of soil will be remediated to achieve the post remediation level of 970 mg/kg for lead and 20 mg/kg for arsenic, as well as the IDEM RISC Industrial Closure Levels for antimony (37 mg/kg), cadmium (77 mg/kg) and selenium (53 mg/kg). The Baseline Human Health Risk Assessment (BHHRA) demonstrated that excavation of the soils with concentrations of lead above the calculated Remedial Action Level (RAL) will result in a post-remediation cancer risk from arsenic ranging from 1×10^{-6} to 7×10^{-6} and a post remediation hazard quotient between 0.03 and 0.2.

The MNA Work Plan is organized as follows:

Section 2.0	Hydrogeologic Conceptual Site Model
Section 3.0	Summary of Previous Groundwater Sampling
Section 4.0	Technical Basis for Monitored Natural Attenuation (MNA)
Section 5.0	MNA Data Collection
Section 6.0	Data Evaluation and Reporting

2.0 HYDROGEOLOGIC CONCEPTUAL SITE MODEL

2.1 PHYSICAL SETTING

The Site is located in the White River Drainage Basin. The Site is situated on a minor local topographic high with a surface elevation of approximately 845 feet above mean sea level (msl). The surface elevation slopes gently to the southeast toward Sloan Ditch, and the northwestern perimeter of the Site slopes to the northwest toward the intermittent headwaters of Beech Creek.

Surface water from the northern portion of the site flows to a drainage ditch along the CSX railroad tracks that eventually runs into an intermittent stream that flows northwest to the headwaters of Beech Creek. Surface water from the eastern and southern areas on the Site historically flowed to the south, eventually discharging to Sloan Ditch. Sloan Ditch flows 0.6 mile west-southwest to Churchman Creek, which flows to the west 0.9 mile and discharges to Beech Creek. Beech Creek flows 1.2 miles to the southwest to Lick Creek, which then flows 7 miles to the White River. Beginning in the early 1980s and continuing until May 2010 storm water runoff from the manufacturing areas of the site was collected, treated as required and discharged to the City of Indianapolis POTW. In the spring of 2010 (following site decontamination and demolition activities) RMC submitted a "No Exposure Certification", which included the results of post decontamination and demolition storm water sampling, for the storm water to IDEM and on May 7, 2010 received a determination that the site is no longer required to manage storm water runoff under IDEM Rule 6 (regarding storm water runoff from industrial activities). Since receipt of that determination, RMC has been discharging storm water collected from the former manufacturing areas into the drainage ditch that drains the northern portions of the site.

2.2 REGIONAL GEOLOGY AND HYDROGEOLOGY

The surficial geology of Marion County is glacial till (Tipton Till Plain) consisting of yellowish-gray, bluish-gray, or gray sand or silt with some clay and pebbles and scattered cobbles and boulders. The drift cover in Marion County is believed to be composed of three drift sheets resulting from the Kansan, Illinoian, and Wisconsin glaciations. Thickness of the glacial till in the region range from less than 15 feet to greater than 400 feet. The Site is underlain by approximately 200 feet of unconsolidated material. Bedrock is encountered at an elevation of approximately 640 feet mean sea level (on the order of 200 feet bgs), and consists of middle Devonian-aged dolomitic limestones. The limestones consist primarily of the Geneva Dolomite and the Jefferson Limestone. The Geneva Dolomite is a light gray to tan and buff to chocolate brown dolomite that contains white crystalline calcite masses. The Jeffersonville Limestone is a pure limestone in the upper portion of the formation, and is laminated with organic material in the lower portion. The organic laminae are more argillaceous than the coralline zone (Harrison, 1963). Meyer, 1975 indicates that shale is present beneath the glacial till and overlying the limestones. Additional detail on the shale unit is not provided by Meyer. The regional dip is to the southwest so that progressively younger formations are encountered below the till plain to the southwest.

Regionally, groundwater is encountered in un-named sand and gravel beds overlying the bedrock, the Jefferson Limestone and Geneva Dolomite, and the Niagaran Limestones (Harrison, 1963). The sand and gravel glacial outwash that coincides with the courses of the White River and Fall Creek is the aquifer of greatest economic importance in Marion County. The location of this aquifer generally coincides with the glacial melt water and outwash deposits along the major streams. Fall Creek enters White River upstream of the Site. The White River sand and gravel aquifer is located approximately 5.3 miles west of the Site.

It is noted by Meyer that three thin, aerially discontinuous, sheet-like deposits of sand and gravel in the till-plain area are separated by beds of silt and clay that cause the groundwater in these deposits to be semi-confined. Meyer also notes that large areas of silt and clay often separate one area of an aquifer from another. The elevation of the uppermost semi-confined aquifer beneath the Site was estimated to be approximately 720 ft msl (approximately 120 feet bgs) and is overlain by deposits of varying thickness of silt and clay, however; as discussed below the uppermost semi-confined aquifer was not encountered during site investigations activities which included boring to 130 feet deep. Groundwater flow in the uppermost regional semi-confined aquifer is reported to be towards the northwest. The middle regional semi-confined aquifer is not mapped beneath the Site because an aquitard (clay unit) is mapped in the area. The elevation of the lower regional semi-confined aquifer in the vicinity of the site is mapped at approximately 660 ft msl (180 ft bgs) with flow towards the southeast.

The average daily industrial and municipal groundwater pumpage for Marion County is 28.95 million gallons per day (mgpd). Less than 20 percent of the industrial/municipal pumpage is from the bedrock. Also, less than 20 percent of the total pumpage is obtained outside the unconfined glacial-outwash aquifer which occurs only along the White River and Fall Creek and is located at least 5.3 miles west of the Site. The major centers of groundwater pumpage occurred within approximately one mile of a major stream. The estimated total domestic groundwater pumpage is 9.0 to 11.0 mgpd (Meyer 1975).

2.3 SITE SPECIFIC GEOLOGY AND HYDROGEOLOGY

Based on results of the RFI activities, the surficial geology at the Site is consistent with the regional geology described in Section 2.2. Shallow surface conditions beneath portions of the Site have been altered as part of original facility construction and subsequent expansion activities. Several topographic high mounds in the wooded area northeast of the manufacturing area and adjacent to the intermittent stream/stormwater drainage ditch are believed to be fill material from on-site construction activities. Similarly, paved areas and areas below the structures on-site have been filled with gravel (i.e. subbase) at thicknesses ranging from 6 to 12 inches.

Four deep borings identified as MW-1D, MW-2D, MW-3D and MW-6D were advanced on-site to depths ranging from 110 feet to 130 feet bgs during the Phase I RFI to characterize subsurface conditions. Borings MW-2D and MW-6D were subsequently converted into monitoring wells as discussed below. The logs for these four deep borings are attached in Appendix A. The screened interval for MW-2D and MW-6D were set in a middle perched zone located 75 to 85 feet below grade. Stratigraphy typically varies from clayey silt to sandy silt, occasionally grading into clay or sand. When encountered, zones of clay or sand were generally thin and laterally discontinuous. The only notable exception was a clay layer encountered in all four deep borings that ranged in thickness from 7 to 12 feet at depths between 50 and 60 feet below ground surface (bgs). A second clay zone was encountered in each of the deep borings at depths typically between 90 and 100 bgs. The thickness of the till plain beneath the Site is at least 110 to 130 feet and the uppermost semi-confined regional aquifer was not encountered in any of the deep borings.

Shallow groundwater encountered at the Site represents a local perched zone of saturation in silty sand and sand layers within the glacial till. The four deep and seven shallow borings advanced during the RFI and CMS, and the five shallow boring logs advanced prior to installation of site monitoring wells MW-1 through MW-5 in 1991 (see Appendix A) indicate that the sand layers vary in thickness and elevation throughout the Site. The piezometric surface for the shallow on-site wells is represented by depth to groundwater measurements obtained during groundwater sampling performed on December, 2001 (Figure 1) and January, 2007 (Figure 2) and are similar to other sampling events. As shown, groundwater flow in the shallow on-site wells appears to be to the southeast beneath the former manufacturing areas (an area covered with buildings and pavement) and towards the east-northeast beneath the areas north of the former manufacturing area. The piezometric surface for the shallow perched groundwater on-site is less than 5 feet bgs and suggests a semi-confined or confined condition when compared against the higher permeability zones noted in the well boring logs. Southeast of the former manufacturing area, shallow groundwater flow heads south. The change in flow appears to be the result of greater amounts of infiltration occurring in the poorly drained grass areas between Arlington Avenue and the former manufacturing area. The area in the general vicinity of MW-11 will typically have standing water.

2.4 AQUIFER CHARACTERISTICS

Sieve analysis performed on shallow wells (MW-6SR, MW-8 and MW-9) installed during the Phase II RFI identified all samples analyzed as sandy silt or silt with sand (USCS Class ML). The vertical coefficient of permeability calculated from Triaxial Variable Head Permeability Test was 4.90×10^{-9} cm/sec from MW-6SR at 10-12 feet (above the screened interval) and 4.03×10^{-8} cm/sec for MW-6SR at 16-18 feet (within the screened interval). Undisturbed samples collected from MW-7 and MW-9 could not be analyzed for permeability because of material characteristics therefore sample analysis was limited grain size analysis. The grain-size distribution curves for the samples from MW-7 and MW-9 were very similar to the MW-6SR 16-18 foot sample and would be expected to have similar permeability.

Depth to groundwater measurements show a northwest to southeast gradient for the shallow perched zone beneath the manufacturing portions of the site ranging from <0.01 ft/ft to approximately 0.02 ft/ft. In the lawn area between the paved manufacturing area and South Arlington Avenue depth to groundwater measurements indicate a northeast to southwest gradient. As stated above, this is believed to be the result of greater amounts of infiltration occurring in the poorly drained lawn area. Where the northwest to southeast gradient beneath the paved manufacturing areas meets the northeast to southwest gradient from the lawn area, the shallow perched groundwater flow assumes a north to south flow direction.

Shallow groundwater conditions have been evaluated through the installation and sampling of twelve (12) shallow monitoring wells. Monitoring well locations are shown on Figures 1 and 2. Groundwater in the shallow zone of saturation beneath the former manufacturing area occurs as perched zones within thin, laterally discontinuous layers of sand and sandy silts contained in clayey-silt and silty-clay glacial deposits.

3.0 SUMMARY OF PREVIOUS GROUNDWATER SAMPLING

The results of groundwater sampling conducted as part of the RFI, Closure Investigation and CMS are provided in Tabular format on Tables 1A through 1L in the Corrective Measures Design Report. Field parameters for all wells are also provided in Tables 1A through 1L. Groundwater sampling performed as part of the RCRA Facility Investigation (RFI) and Closure Investigation have identified lead above 42 ug/L (IDEM Industrial Default RISC Criteria) in unfiltered groundwater samples on more than one occasion in groundwater monitoring wells MW-2 and MW-7. Investigation activities have identified arsenic above 10 ug/L (MCL and IDEM Industrial Default RISC Criteria) in filtered (i.e., dissolved) and unfiltered groundwater samples on more than one occasion in groundwater monitoring wells MW-1, MW-7 and MW-8, and on more than one occasion in only unfiltered samples in MW-2S, MW-3 and MW-10. A graphical presentation of filtered and unfiltered results for lead and arsenic for all the wells are presented on Figures 3A, 3B, 4A and 4C. Figure 2 provides isoconcentration lines for unfiltered lead and arsenic results for the January 2007 groundwater sampling event.

4.0 TECHNICAL BASIS FOR MONITORED NATURAL ATTENUATION

Results of the groundwater sampling did not reveal site-wide groundwater impacts; however, results did detect arsenic and lead above the screening levels utilized for this project in multiple samples from several wells. Therefore, USEPA has requested that shallow groundwater be included as a component of the Corrective Measures for the site and Monitored Natural Attenuation (MNA) has been selected as the remedy.

4.1 POTENTIAL SOURCE AREAS

4.1.1 Outdoor Feed Pile Storage Areas

As represented on Figures 1 and 2, the areas that lead exceeds the IDEM Industrial Default RISC Criteria and arsenic exceeds the MCL coincide with those areas of the site where the most intensive activities associated with the recycling operations occurred. Site operations consisted of recycling lead acid batteries to recover the lead. During the early operations (prior to 1984) battery breaking, the process used to separate the lead cores from the electrolyte (dilute sulfuric acid) and the casings, was conducted off-site and only the lead bearing components (grids, posts and oxide paste) were delivered to the site for smelting and refining. Materials received for processing were managed in piles prior to being fed into the furnace. The piles were situated on unpaved areas within the footprint of the Hazardous Waste Management Units (HWMUs) identified as the "Outdoor Waste Piles" or material Storage Building".

Beginning in 1984 and continuing until the end of facility operations in 1995, the site operated its own battery breaker, which included cutting or breaking open the batteries; separating the casings for off-site plastics recycling; collecting and neutralizing the acid prior to discharge to the POTW; and retaining the lead bearing components for smelting and refining. Facility improvements completed during the mid to late 1980s included paving site and eventually included the elimination of managing feed material outdoors.

Management of feed materials in outdoor piles is believed to be the most significant period of facility operations for impacting the shallow perched groundwater. The piles provided both a source for lead and arsenic and a mechanism capable of dissolving and transporting them into the subsurface (i.e., precipitation reacting with residual acid contained in the feed materials causing leaching).

4.1.2 Impacted Surface Materials

Sampling conducted in the area north of the battery breaker building and material storage building (representing outdoor waste piles 1 and 2 and containing MW-2, MW-7 and MW-8) identified fill materials with the highest concentrations of lead (up to 475,000 mg/kg) and arsenic (up to 2,730 mg/kg) on-site. These fill materials are believed to be a combination of residual amounts of the feed materials managed in the outdoor waste piles and filling performed as part of the grading required to internalize site storm water drainage.

Although with significantly lower concentrations of lead and arsenic relative to the area north of the battery breaker building, the unpaved area in vicinity of MW-1 was identified to contain shallow surface soils with lead up to 32,000 mg/kg and arsenic up to 359 mg/kg. These materials are believed to be the result of minor filling with contaminated soils. This area has been unpaved throughout the operating history of the facility and would have been susceptible to infiltrations that could potentially mobilize and infiltrate lead and/or arsenic.

4.2 PROPOSED SOURCE REMOVAL

The potential source areas for lead and arsenic impacts on groundwater are presented on Figures 1 and 2. Although not believed to be as significant a contributor as the outdoor waste pile area (because the area was under roof), we have also included the material storage building as a potential source area since lead bearing material was actively managed in this area and the floor was observed to be in poor condition at the time of facility closure. As shown on the Corrective Measures Design Drawings, the primary remedial activity will be the excavation of the most highly impacted soils at the site, including extensive excavation activities in the areas identified as potential source areas.

Based on a limited amount of SPLP Testing (USEPA Method 1312) conducted during the Corrective Measures Study, the average partitioning coefficients for lead and arsenic were 6,901 L/kg and 3,917 L/kg respectively. Utilizing these results and the IDEM Industrial Default RISC Criteria for arsenic and lead in groundwater in a Soil to Groundwater Partitioning Model with a ½ acre area (DAF = 20); the soil concentrations with the potential to cause unacceptable impact to groundwater are approximately 5,800 mg/kg lead and 780 mg/kg arsenic.

Following completion of soil remediation within the area in vicinity of MW-1, the average remaining lead and arsenic concentrations will be less than 800 mg/kg and 15 mg/kg, respectively. The locations of the former outdoor waste pile and material storage building areas will have even lower post remediation concentrations. Source removal, in the form of the proposed soil and sediment remediation activities is a critical component for realizing successful natural attenuation.

5.0 MNA DATA COLLECTION

5.1 GENERAL

Based on the results of previous groundwater sampling, the hydrogeologic conceptual site model, and an understanding of the operating history of the facility; the area of site groundwater that will be the subject of MNA has been delineated as shown on Figure 2. Monitoring activities will involve establishing a network of wells capable of providing information regarding the potentiometric surface and groundwater quality over time. A description of the proposed network and procedures for obtaining reliable information regarding groundwater elevations and representative analytical data is provided in the following sections.

5.2 GROUNDWATER SAMPLING LOCATIONS

As described above, the shallow perched groundwater zone has been monitored using 12 monitoring wells installed between 1990 and 2005. To the extent practicable, the groundwater sampling locations to be utilized for MNA will rely on existing monitoring wells. Specifically, existing wells MW-1, MW-2, MW-3, MW-8, MW-9 and MW-12 will be utilized as part of the MNA sampling network. In addition, the proposed monitoring wells CC-1 through CC-6 will serve the dual purpose of monitoring the containment cell and being part of the MNA sampling network. Figure 2 presents the proposed groundwater monitoring network. These wells have been selected as they bound the MNA monitoring zone as depicted on Figure 2. Existing wells MW-7 and MW-10 are not included as part of the proposed MNA sampling network because they are located in the prepared containment cell location and are proposed for abandonment as part of the proposed corrective measures. Abandonment will be performed in accordance with the requirements of IDEM and Marion County Indiana. Well CC-6 will be installed at a location in the nearest downgradient location from the MW-7 and MW-10 locations which is outside the prepared containment cell footprint and will provide ample groundwater data for this area.

Proposed wells CC-1 through CC-6 will be installed during the corrective measures implementation after the containment cell berms and perimeter access roads have been constructed. During installation of CC-1 through CC-6, at least two (2) soil samples will be collected for chemical analysis from each boring. The one sample each will be collected from the unsaturated overburden soils and from within the proposed screen horizon in each boring utilizing split spoon sampling techniques. Soil samples will be submitted for laboratory pH and eH, target analyte list (TAL) metals, arsenic speciation (arsenite/arsenate), iron speciation (ferric/ferrous), manganese speciation (MnII/MnVII), total organic carbon and sulfate. Samples from the same depth/intervals will also be submitted for gradation (sieve and hydrometer analysis). Permeability testing will be performed in existing wells MW-1, MW-2, MW-8 and MW-9 and proposed wells CC-1, CC-3 and CC-6. Permeability testing shall be performed using slug tests (ASTM D4044 - 96(2008)).

5.3 WATER LEVEL MEASUREMENTS

At the start of each MNA groundwater sampling event, depth to water measurements will be obtained in general accordance with the American Society of Testing Materials (ASTM D 4750-97) procedures from all on-site wells. Depth to water measurements and date and time of measurement will be recorded to the nearest 0.01 ft in a bound field log book by the Technician performing the measurements. The total depth of the well will also be recorded (after the completion of groundwater sampling). At the time of gauging the field technician will also make any notations regarding the condition of the wells (including unsecured, broken or missing locks).

Depth to water level measurements will be taken from an established point at the top of the PVC riser pipe. Depth to water measurements will be obtained by carefully lowering an electronic water level indicator avoiding contact with the casing to the extent possible. The water level indicator probe will be decontaminated between each well. Additional information regarding the collection of water level measurements are included as part of the RMC Beech Grove Groundwater Sampling Plan, as approved by IDEM in June, 2007.

Results of the depth to groundwater level measurements will be used to develop a potentiometric groundwater contour map for the shallow perched groundwater. Addition of the proposed CC wells will also allow refinement of groundwater flow in the northern portions of the site.

5.4 MONITORED NATURAL ATTENUATION GROUNDWATER SAMPLING FREQUENCY

The MNA groundwater monitoring wells will be sampled beginning approximately one month following installation of the proposed containment cell monitoring wells. Sampling will be performed once every calendar quarter for twelve consecutive quarters with the first evaluation regarding future frequency performed after completion of the second year of monitoring (i.e., after 8 quarters). Monitoring will end when the sampling results demonstrate that the remedial goals have been attained for four consecutive quarters. If analysis after the first 12 consecutive quarters indicate increasing concentrations, RMC will continue quarterly sampling while evaluating the observed results and developing an alternate strategy for mitigating impacts.

Sampling and analysis of containment cell groundwater monitoring wells will continue at the frequencies established in the Corrective Measures Design Report even after cessation of MNA groundwater monitoring.

5.5 GROUNDWATER ANALYTIC PARAMETER

During the first two quarterly groundwater sampling events samples will be analyzed for total and dissolved arsenic and lead, sulfide, sulfate, nitrate arsenic speciation (arsenite/arsenate), iron speciation (ferric/ferrous), and manganese speciation (MnII/MnVII) for use in geochemical modeling. Beginning after the second quarterly groundwater sampling event groundwater analysis will be limited to total and dissolved lead and arsenic, unless additional geochemical modeling is deemed approriate. Field parameter readings to be recorded at the time of sample collection during all groundwater sampling events shall include temperature; pH; Eh; dissolved oxygen (DO); specific conductance and turbidity.

6.0 DATA EVALUATION AND REPORTING

6.1 GENERAL

Monitored Natural Attenuation (MNA) of inorganic constituents like lead and arsenic in most settings is predominantly the result of sorption, precipitation, oxidation/reduction, advection, dispersion and/or diffusion. For the RMC site, initial information regarding the properties of the perched groundwater zone indicates low permeability soils (even within the saturated zones) and significant amounts of clay. Groundwater sampling has identified site wide near neutral pH conditions, neutral to slightly positive ORP (typically <100 mV). Based on these observations sorption is expected to be the dominant MNA process that can be anticipated going forward.

6.2 INITIAL DATA EVALUATION

Following completion of the second quarterly groundwater sampling event potentiometric groundwater contour maps for the first two sampling events will be developed. The maps will be provided as a figure in an initial report that also presents and discusses the results of groundwater analysis. The report will provide an initial interpretation of the observed results for both groundwater and aquifer testing including geochemical physical characteristics. The results of the initial analysis will be utilized to perform computational speciation modeling using PHREEQC2 or similar program. Results of the modeling will be included with the initial data evaluation report. The RMC property boundaries will be considered the point of compliance with evaluating the data.

Trends analysis will not be performed until after 4 rounds of post-remediation groundwater sampling results have been obtained. A side by side comparison of observed total and dissolved lead and arsenic concentrations will be performed as part of the initial evaluation.

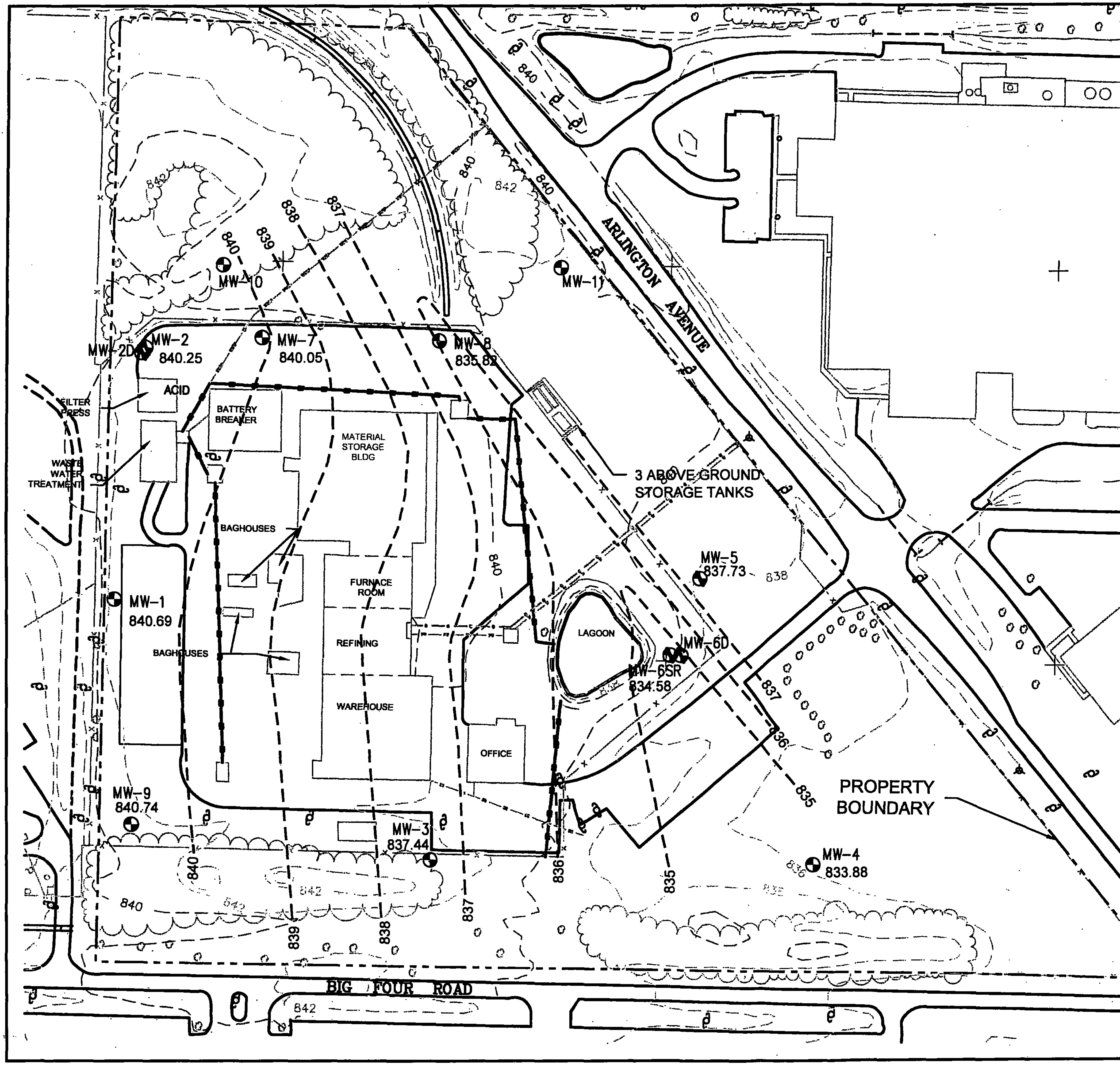
6.3 ANNUAL REPORTING AND TREND ANALYSIS

Results for arsenic and lead will be evaluated annually beginning after the collection of the fourth sampling event. Results will be initially evaluated against their corresponding actions levels (lead 42 ug/L and arsenic 10 ug/L) to identify those wells with observed exceedances. For those groundwater monitoring wells where exceedances are observed a subsequent evaluation will be performed using the Mann-Kendall (M-K) test to evaluate trends in the data on a well by well basis to determine if the plume is expanding (concentrations increasing), shrinking (concentrations decreasing), or stable. The M-K test is a non-parametric test used to evaluate trends in small data sets that are not normally or log-normally distributed. The test usually requires a minimum of four consecutive sets of data to provide representative results.

The M-K test will provide S-statistics for a comparison to a desired probability of 0.1 (α). A probability of 0.1 has been selected because it implies that there is only a 10% chance that random fluctuations would suggest a trend when a trend does not actually exist and is considered an acceptable Type I error. Given the desire to minimize the possibility of a Type II error (i.e. concluding that no trend exists, when one does exist), alpha = 0.1 is considered reasonable and appropriate given the absence of groundwater receptors at the site.

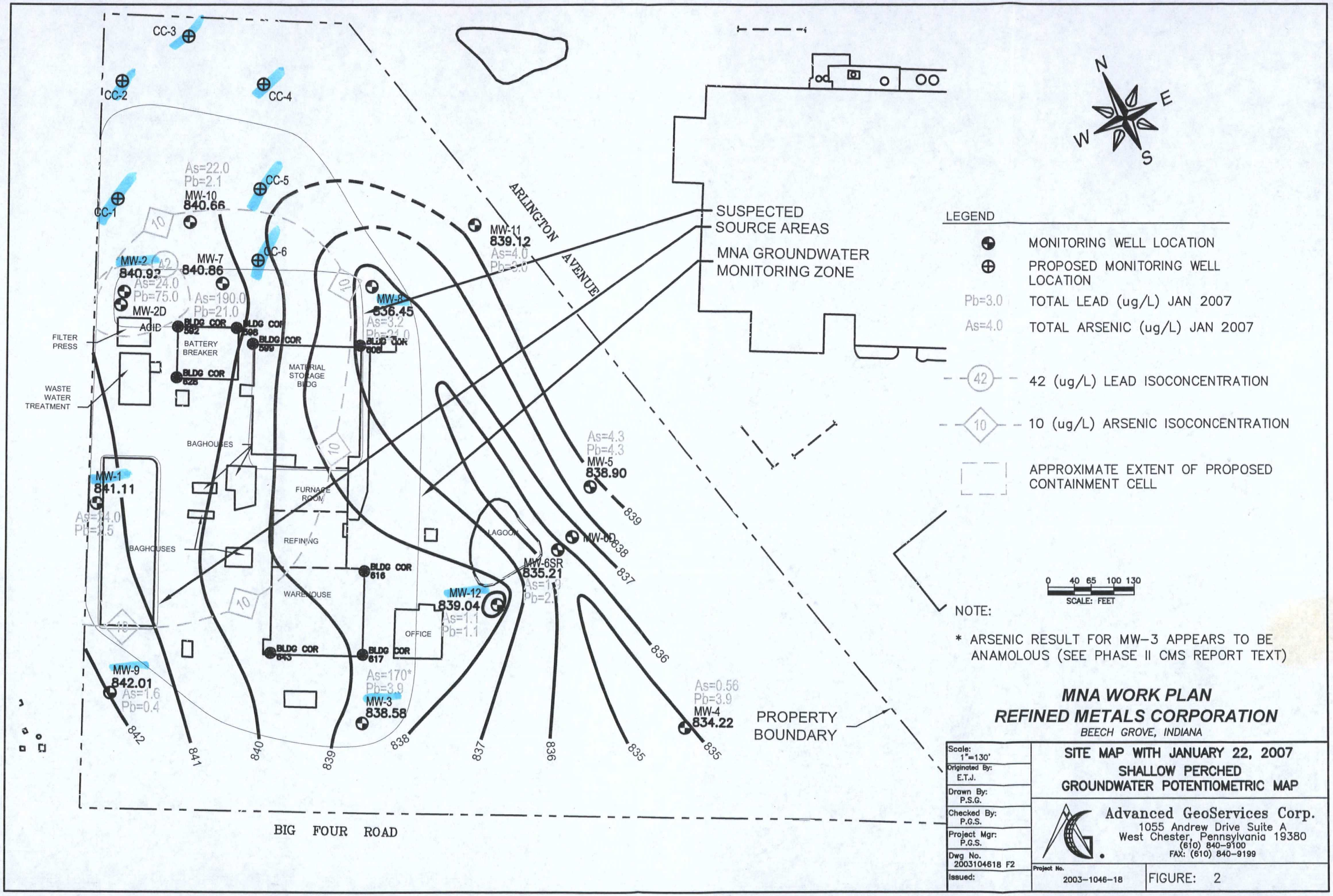
The annual report will include quarterly groundwater contour maps, additive results table (i.e. including all previous results beginning after the completion of the proposed Corrective Measures), and the results of statistical analysis. Evaluations of compliance will be performed relative to concentrations at the RMC property boundary.

FIGURES



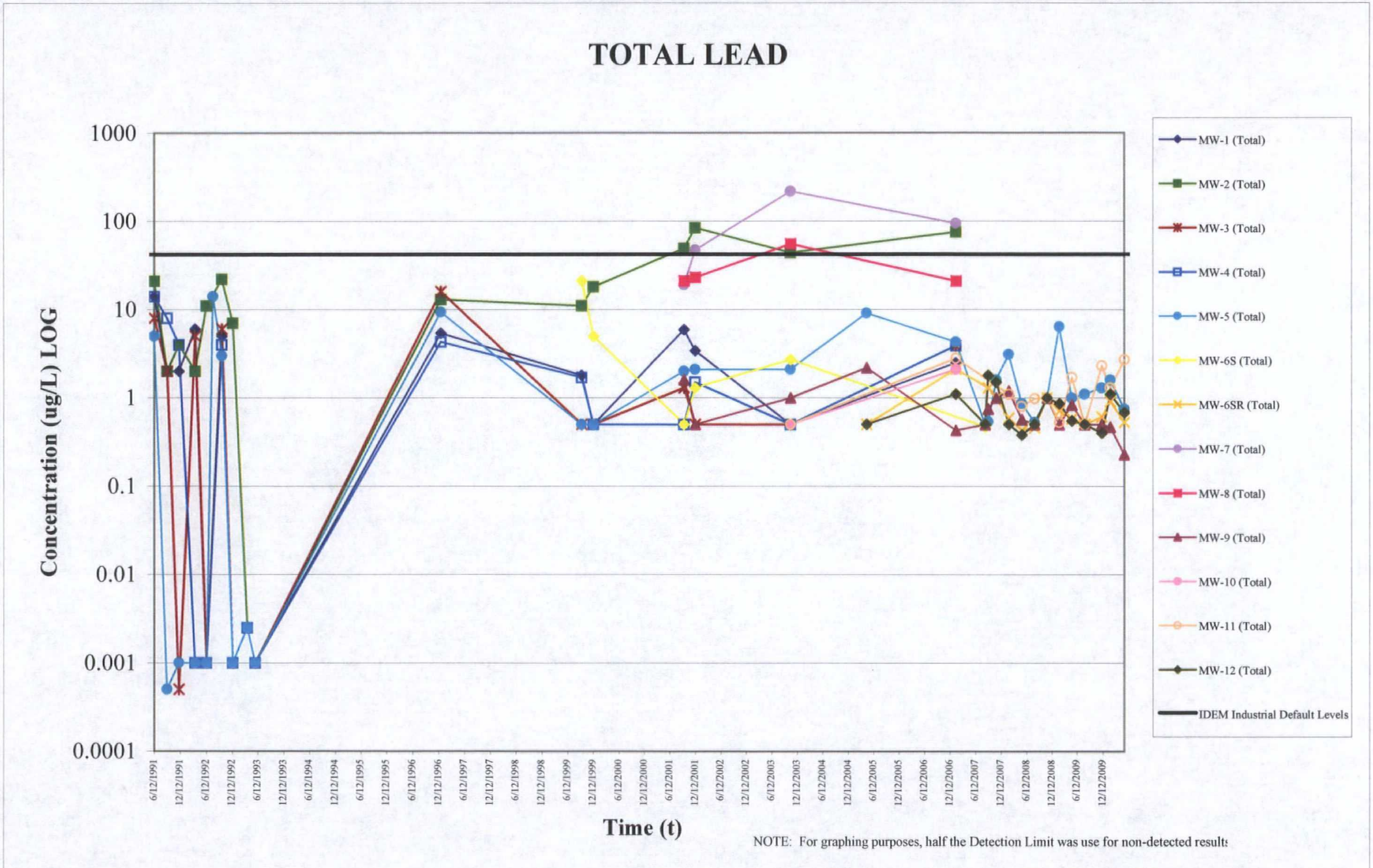
MNA WORK PLAN
REFINED METALS CORPORATION
BEECH GROVE, INDIANA

Scale: 1"=130'	SITE MONITORING WELL LOCATIONS POTENTIOMETRIC MAP DECEMBER 2001
Originated By: P.G.S.	
Drawn By: P.S.G.	
Checked By: P.G.S.	Advanced GeoServices Corp. 1055 Andrew Drive Suite A West Chester, Pennsylvania 19380 (610) 840-9100 FAX: (610) 840-9199
Project Mgr: P.G.S.	
Dwg No. 2003104618-F1	
Issued:	Project No. 2003-1046-18 · FIGURE: 1



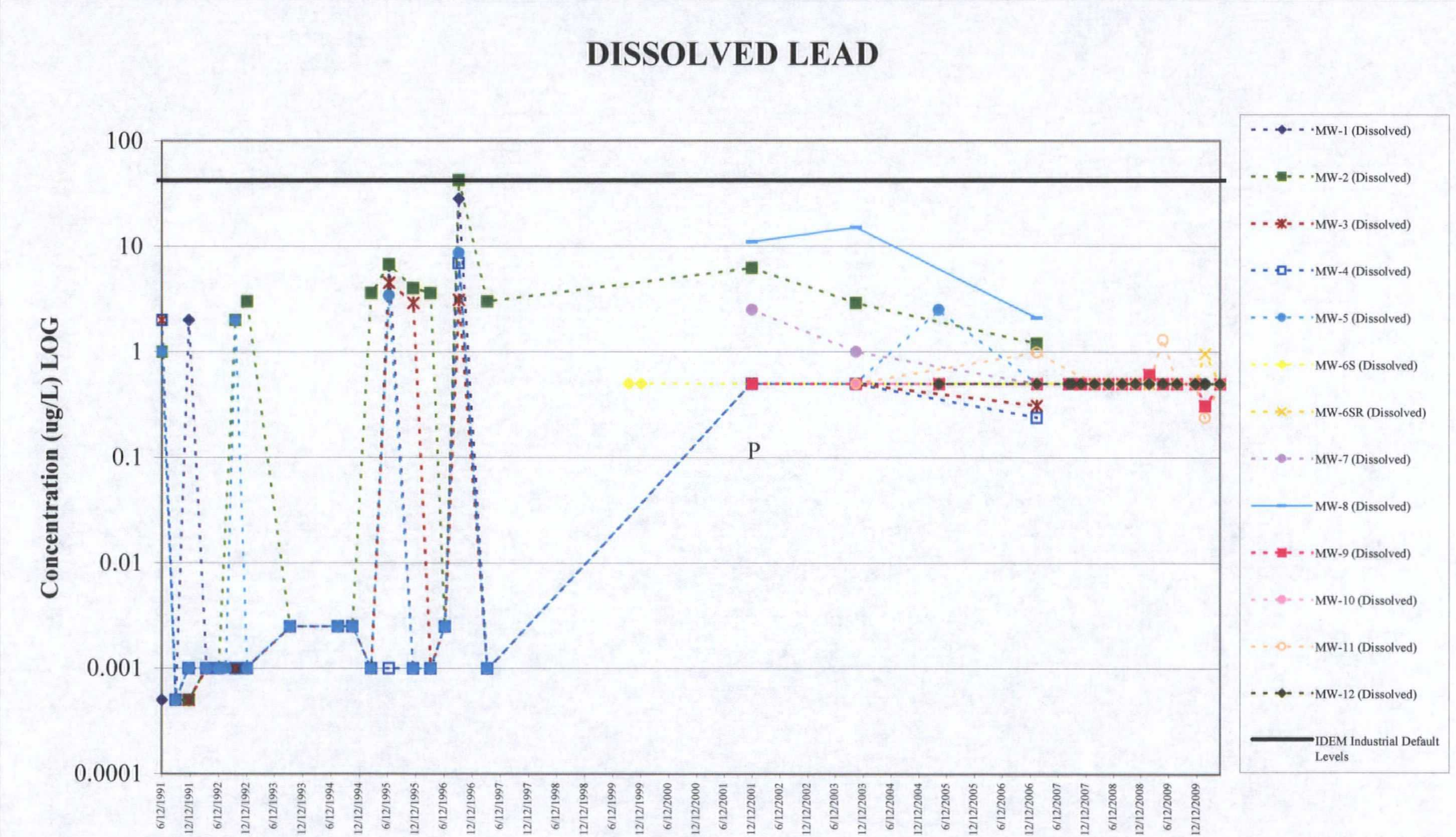
CC-3
CC-2
CC-4
CC-1
CC-5
CC-6
As=22.0
Pb=2.1
MW-10
840.66
MW-2
840.92
As=24.0
Pb=75.0
MW-2D
MW-7
840.86
As=190.0
Pb=21.0
MW-8
836.45
As=3.2
Pb=21.0
MW-11
839.12
As=4.0
Pb=3.0
ARLINGTON AVENUE
FILTER PRESS
ACID
BATTERY BREAKER
BLDG COR 592
BLDG COR 598
BLDG COR 599
BLDG COR 608
BLDG COR 626
MATERIAL STORAGE BLDG
WASTE WATER TREATMENT
BAGHOUSES
MW-1
841.11
As=14.0
Pb=2.5
FURNACE ROOM
REFINING
BAGHOUSES
LAGOON
BLDG COR 616
WAREHOUSE
MW-12
839.04
As=1.1
Pb=1.1
OFFICE
BLDG COR 643
BLDG COR 617
As=170*
Pb=3.9
MW-3
838.58
MW-9
842.01
As=1.6
Pb=0.4
As=4.3
Pb=4.3
MW-5
838.90
MW-6D
MW-6SR
835.21
As=1.0
Pb=2.1
As=0.56
Pb=3.9
MW-4
834.22
842
841
840
839
838
837
836
835
10
42
SUSPECTED SOURCE AREAS
MNA GROUNDWATER MONITORING ZONE
PROPERTY BOUNDARY
BIG FOUR ROAD
N
E
W
S
LEGEND
MONITORING WELL LOCATION
PROPOSED MONITORING WELL LOCATION
Pb=3.0 TOTAL LEAD (ug/L) JAN 2007
As=4.0 TOTAL ARSENIC (ug/L) JAN 2007
42 (ug/L) LEAD ISOCONCENTRATION
10 (ug/L) ARSENIC ISOCONCENTRATION
APPROXIMATE EXTENT OF PROPOSED CONTAINMENT CELL
0 40 65 100 130
SCALE: FEET
NOTE:
* ARSENIC RESULT FOR MW-3 APPEARS TO BE ANAMOLOUS (SEE PHASE II CMS REPORT TEXT)
MNA WORK PLAN
REFINED METALS CORPORATION
BEECH GROVE, INDIANA
Scale: 1"=130'
Originated By: E.T.J.
Drawn By: P.S.G.
Checked By: P.G.S.
Project Mgr: P.G.S.
Dwg No. 2003104618 F2
Issued:
SITE MAP WITH JANUARY 22, 2007 SHALLOW PERCHED GROUNDWATER POTENTIOMETRIC MAP
Advanced GeoServices Corp.
1055 Andrew Drive Suite A
West Chester, Pennsylvania 19380
(610) 840-9100
FAX: (610) 840-9199
Project No. 2003-1046-18
FIGURE: 2

FIGURE 3A
HISTORIC GROUNDWATER RESULTS (TOTAL LEAD)
REFINED METALS CORP., BEECH GROVE, IN



F:\OFICEAGC\PROJECTS\Files\2003-1046\Reports\Final Design 10-10\MNA Work Plan\Historic Metals graphs 8-2010.xlsLead (Total) Graph

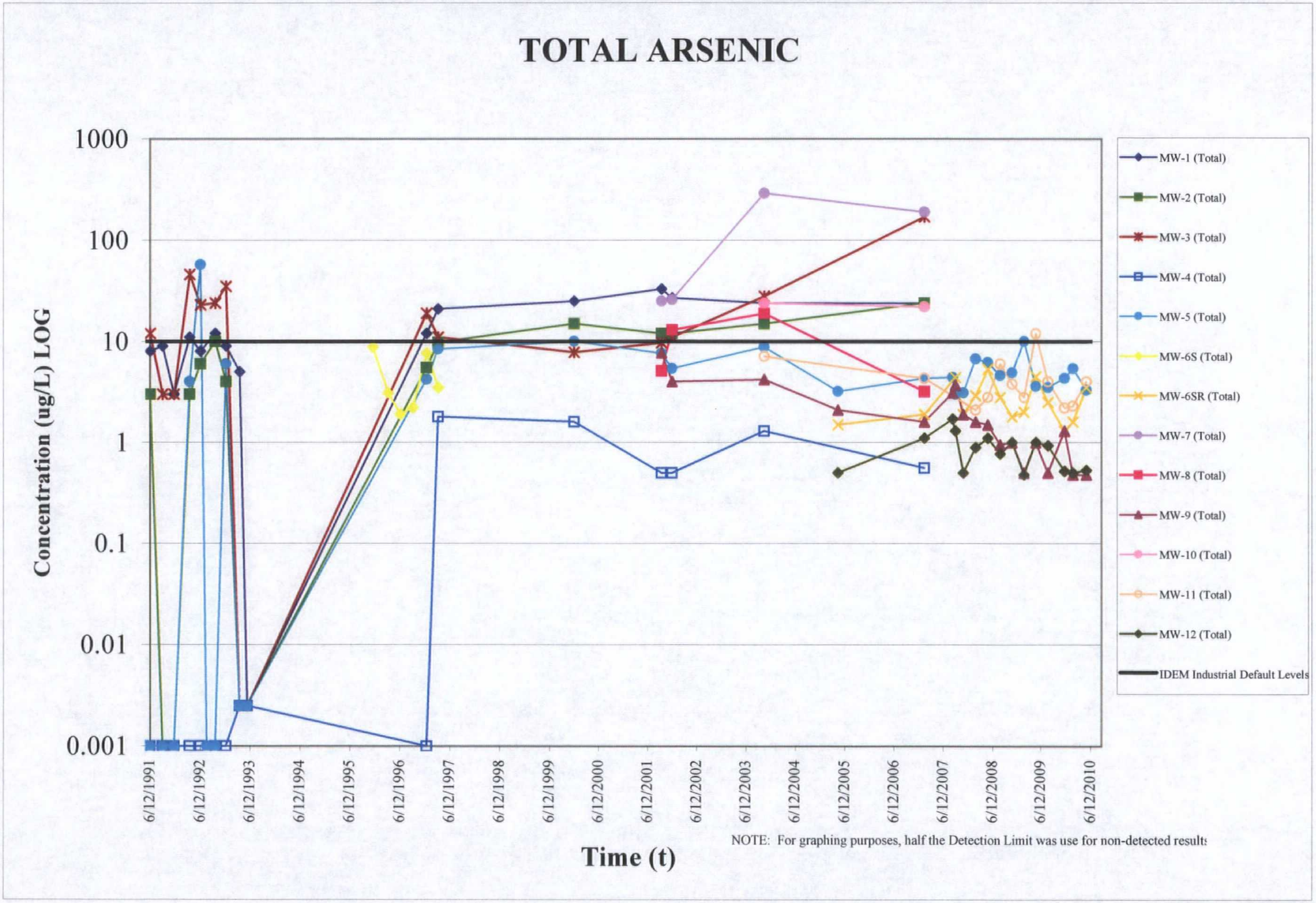
FIGURE 3B
HISTORIC GROUNDWATER RESULTS (DISSOLVED LEAD)
REFINED METALS CORP., BEECH GROVE, IN



NOTE: For graphing purposes, half the Detection Limit was use for non-detected results

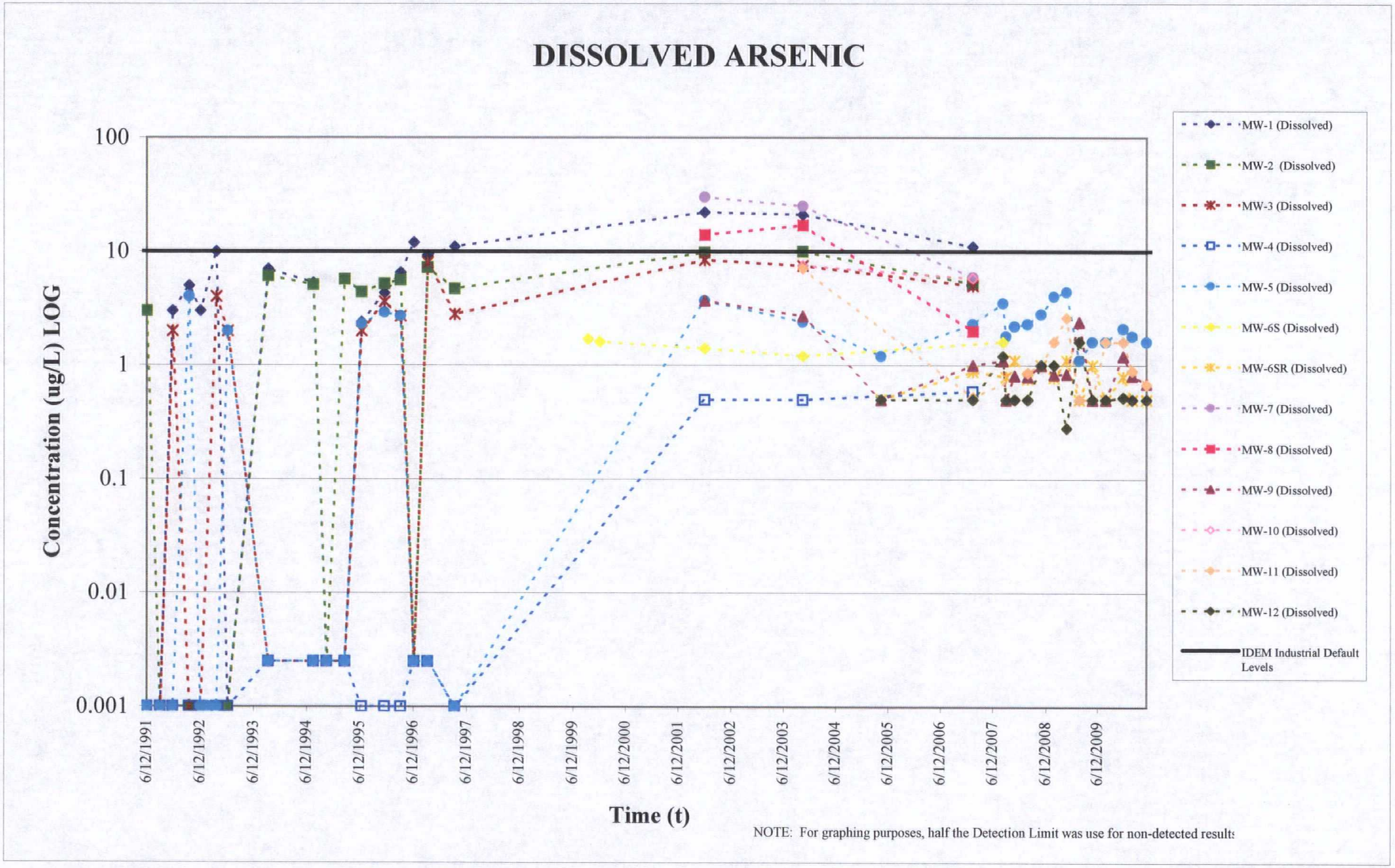
F:\OFICEAGC\PROJECTS\Files\2003-1046\Reports\Final Design 10-10\MNA Work Plan\Historic Metals graphs 8-2010.xlsLead (Dissolved) Graph

FIGURE 4A
HISTORIC GROUNDWATER RESULTS (DISSOLVED ARSENIC)
REFINED METALS CORP., BEECH GROVE, IN



F:\OFICEAGC\PROJECTS\Files\2003-1046\Reports\Final Design 10-10\MNA Work Plan\Historic Metals graphs 8-2010.xlsArsenic (Total) Graph Chart 1

FIGURE 4B
HISTORIC GROUNDWATER RESULTS (DISSOLVED ARSENIC)
REFINED METALS CORP., BEECH GROVE, IN



APPENDIX A

Boring Logs

FULLER, MOSSBARGER, SCOTT AND MAY
CIVIL ENGINEERS, INC.
LEXINGTON, LOUISVILLE, KENTUCKY

SUBSURFACE LOG

JECT NAME:	Marion, Indiana Refined Metals Corporation	PROJECT NUMBER:	90226
FACE ELEVATION:	N/A	LOCATION:	Hole #1
LLER:	Craig Avery/David Mullins	DATE STARTED:	10/11/90 COMPLETED: 10/11/90
JECT TYPE:	Monitoring Well Installation	LOGGED BY:	Don Armour
E NUMBER:	1 TOTAL DEPTH: 30.0'	DEPTH TO WATER:	IMMEDIATE: 6.0'
		DEPTH TO WATER:	DAYS AFTER COMPL: ——

LITHOLOGY EV.	LITHOLOGY DEPTH	DESCRIPTION	OVERBURDEN	SAMP.NO.	DEPTH	REC.FT.	BLOWS	TYPE	REMARKS
	5.0	Fill: intermixed clay, sandy clay, and construction debris (Excavated with backhoe)							
		Silty clay, brown, moist, medium stiff; with some sand and gravel		1	10.0-11.5	1.5	3/3/5	SPT	
				2	15.0-16.5	1.0	5/7/14	SPT	
	21.0			3	20.0-21.5	1.0	8/16/29	SPT	
	30.0	Sand, brown, fine to medium grained, medium dense		4	28.5-30.0	0.0	50+	SPT	
		Bottom of Hole - 30.0'							

FULLER, MOSSBARGER, SCOTT AND MAY
CIVIL ENGINEERS, INC.
LEXINGTON, LOUISVILLE, KENTUCKY

SUBSURFACE LOG

COUNTY: Marion, Indiana
PROJECT NAME: Refined Metals Corporation
SURFACE ELEVATION: N/A
DRILLER: Craig Avery/David Mullins
PROJECT TYPE: Monitoring Well Installation
HOLE NUMBER: 2 TOTAL DEPTH: 30.0'

PROJECT NUMBER: 90226
LOCATION: Hole #2
DATE STARTED: 10/10/90 COMPLETED: 10/11/90
LOGGED BY: Don Armour
DEPTH TO WATER: IMMEDIATE: 9.7' (0730 hrs.; 10/11/90)
DEPTH TO WATER: DAYS AFTER COMPL: 6.9' (1515 hrs.; 10/11/90)

LITHOLOGY ELEV.	DEPTH	DESCRIPTION OVERBURDEN	SAMP. NO.	DEPTH	REC. FT.	BLOWS	TYPE	REMARKS
	0.0	Silty clay, brown, moist, medium stiff; with some sand and gravel						
			1	5.0-6.5	1.5	4/3/5	SPT	
			2	10.0-11.5	1.5	4/6/8	SPT	
			3	15.0-16.5	1.0	5/10/18	SPT	
	20.0							
		Clayey sand and silt, brown, wet, medium dense	4	20.0-21.5	0.0	3/5/15	SPT	
			5	25.0-26.5	1.0	8/12/20	SPT	
	28.0							
	30.0	Clay, gray, moist, stiff; with occasional gravel	6	28.5-30.0	1.5	10/22/31	SPT	
		Bottom of Hole - 30.0'						

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SUBSURFACE LOG

...NT.	Marion, Indiana	PROJECT NUMBER:	90226
...JECT NAME:	Refined Metals Corporation	LOCATION:	Hole #3
...FACE ELEVATION:	N/A	DATE STARTED:	10/17/90 COMPLETED: 10/17/90
...ILLER:	Craig Avery/David Mullins	LOGGED BY:	Don Armour
...JECT TYPE:	Monitoring Well Installation	DEPTH TO WATER:	IMMEDIATE: —
...E NUMBER:	3 TOTAL DEPTH: 21.5'	DEPTH TO WATER:	DAYS AFTER COMPL: —

LITHOLOGY ELEV.	LITHOLOGY DEPTH	DESCRIPTION OVERBURDEN	SAMP. NO.	DEPTH	REC. FT.	BLOWS	TYPE	REMARKS
		Silty clay, brown, moist, medium stiff; with some sand and gravel						
			1	5.0-6.5	1.5	7/13/15	SPT	
	11.0		2	10.0-11.5	1.0	4/8/14	SPT	
		Clayey sand and silt, brown, wet, medium dense						
			3	15.0-16.5	1.0	8/21/32	SPT	
	20.0		4	20.0-21.5	1.5	12/20/50	SPT	
	21.5	Clay, gray, moist, stiff; with occasional gravel						
		Bottom of Hole - 21.5'						

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SUBSURFACE LOG

	Marion, Indiana	PROJECT NUMBER:	90226
PROJECT NAME:	Refined Metals Corporation	LOCATION:	Hole #4
SURFACE ELEVATION:	N/A	DATE STARTED:	10/15/90 COMPLETED: 10/15/90
DRILLER:	Craig Avery/David Mullins	LOGGED BY:	Don Armour
PROJECT TYPE:	Monitoring Well Installation	DEPTH TO WATER:	IMMEDIATE: —
HOLE NUMBER:	4 TOTAL DEPTH: 26.0'	DEPTH TO WATER:	DAYS AFTER COMPL: —

LITHOLOGY ELEV.	LITHOLOGY DEPTH	DESCRIPTION OVERBURDEN	SAMP. NO.	DEPTH	REC. FT.	BLOWS	TYPE	REMARKS
		Silty clay, brown, moist, medium stiff; with some sand and gravel						
			1	5.0-6.5	1.5	2/1/2	SPT	
			2	10.0-11.5	1.0	5/5/11	SPT	
	15.0		3	15.0-16.5	1.0	12/17/13	SPT	
		Clayey sand and silt, brown, wet, medium dense						
	22.0		4	20.0-21.5	1.0	16/38/43	SPT	
		Clay, gray, moist, very stiff with occasional gravel						
	26.0		5	24.5-26.0	1.5	9/22/20	SPT	
		Bottom of Hole - 26.0'						

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SUBSURFACE LOG

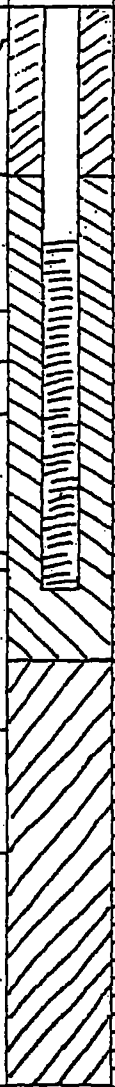
	Marion, Indiana	PROJECT NUMBER:	50226
NAME:	Refined Metals Corporation	LOCATION:	Hole #5
SURFACE ELEVATION:	N/A	DATE STARTED:	10/12/90 COMPLETED: 10/12/90
DRILLER:	Craig Avery/David Mullins	LOGGED BY:	Don Armour
BORING TYPE:	Monitoring Well Installation	DEPTH TO WATER: IMMEDIATE:	10' (0900 hrs.; 10/12/90)
HOLE NUMBER:	5 TOTAL DEPTH: 25.0'	DEPTH TO WATER: DAYS AFTER COMPL:	---

LITHOLOGY ELEV.	LITHOLOGY DEPTH	DESCRIPTION OVERBURDEN	SAMP.NO.	DEPTH	REC.FT.	BLOWS	TYPE	REMARKS
	1.0	Topsoil						
		Silty clay, brown, moist, medium stiff; with some sand and gravel	1	5.0-6.5	1.5	2/3/3	SPT	
			2	10.0-11.5	1.0	5/8/17	SPT	
	15.0		3	15.0-16.5	1.0	14/20/14	SPT	
		Clayey sand and silt, brown, wet, medium dense Gravel 16.0-17.0						
	25.0							
		Bottom of Hole - 25.0'						

BORING LOG

PAGE 1 OF 1

PROJECT NUMBER: 98-478-03	PROJECT NAME: RML- Beech Grove	
BORING / WELL NUMBER: MW-6s	LOCATION: Beech Grove Indiana	
DIAMETER: 2"	WATER DEPTH: 16.0'	DATE/TIME: 8/12/99 @ 1400
GEOLOGIST: Eric Stanke	COMPLETION DEPTH: 17.0'	DATE STARTED: 8/12/99
DRILLING METHOD: HSA	SAMPLING METHOD: Split Spoon	DATE COMPLETED: 8/12/99
DRILLING SUBCONTRACTOR: Boart Longyear	DEVELOPMENT METHOD: Surge Block/pump	YIELD: ~ 0.5 gpm

DESCRIPTION	WELL CONSTRUCTION	DEPTH (FT.)	PENETRATION BLOWS PER 6 IN.	RECOVERY (FT.)	INSTRUMENT READING	SAMPLE NUMBER	REMARKS
0.0-1.0' SILT, tan with a trace of organics and subangular to angular gravel - dry (1.0')			Data not collected.	Data not collected.	Not applicable.	Not applicable.	On 8/12/99 use 6" HSA and split spoons to determine where to set well. Well installed on 8/12/99
1.0'-5.0' SILT, tan with a trace of subangular to angular gravel - dry (5.0')		5					
5.0'-9.0' SILT, black with a trace of organics - moist (medium dense) (9.0')							
9.0'-10.5' CLAY, light brown with a trace of silt and angular gravel - moist (medium dense) (10.5')		10					
10.5'-12.0' CLAY, brown with a trace of angular to subrounded gravel - wet (loose) (12.0')							
12.0'-16.0' CLAY, brown and dark brown mottled with a trace of fine sand, silt and angular gravel - moist (medium dense) (16.0')		15					
16.0'-16.5' SILT, light brown with angular to rounded gravel - wet (loose) (16.5')							6" borehole with bentonite and 2" PVC casing
16.5'-21.0' CLAY, dark gray with a trace of fine sand and gravel - moist (medium dense) (21.0')		20					6" borehole with #5 sand and 2" diameter PVC casing
21.0'-24.5' fine sandy SILT, gray - moist (loose) (24.5')							6" borehole with #5 sand and 0.01" slot 2" diameter PVC casing
24.5'-31.0' medium SAND, gray with a trace of silt - moist (loose)		25					6" borehole with #5 sand
		30					6" borehole with bentonite
Boring terminated at 31.0'. Well screened from 7.0' to 17.0' bgs.							

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BORING LOG

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PROJECT NUMBER: 98-478-05	PROJECT NAME: RMC - Beech Grove		
BORING / WELL NUMBER: MW-65R	LOCATION: Beech Grove, Indiana		
DIAMETER: 4"	WATER DEPTH: 12.5'	DATE/TIME: 8/21/01	
GEOLOGIST: Brendan O'Donnell	COMPLETION DEPTH: 30.0'	DATE STARTED: 8/21/01	
DRILLING METHOD: HSA	SAMPLING METHOD: HSA/SS	DATE COMPLETED: 8/21/01	
DRILLING SUBCONTRACTOR: Boart Longyear	DEVELOPMENT METHOD: Surged Block	YIELD: —	

DESCRIPTION	WELL CONSTRUCTION	DEPTH (FT.)	PENETRATION BLOWS PER 6 IN.	RECOVERY (FT.)	INSTRUMENT READING	SAMPLE NUMBER	REMARKS
0.0-5.0 Clay, brown-orange, dry with topsoil and sand, stiff		0-5	8,8; 10,12; 7,10; 11,16	data not collected	NA		Well Construction Riser: Sch. 40 PVC 0'-20' Screen: 0.010 slot Sch. 40 PVC 20'-30' Sandpack: #1 Sand 18'-30' Bentonite Seal: 16'-18' Grout: 95% type I Portland 5% Bentonite 0'-16'
5.0-10.0 Clay, brown-gray, moist stiff		5	5,7; 11,15; 5,10; 11,13; 10,10				
10.0-15.0 Sandy Silt, brown-gray, stiff, moist to saturated, (ML)		10	14,12; —; —; 9,9; 11,13				
15.0-20.0 Sandy Silt, gray, stiff Saturated, (ML)		15	14,12; 15,15; —; —; 13,14				Shelby Tube Collected at: 10'-12' 16'-18' For Sieve & Hydro Testing
20.0-25.0 Sandy Silt, gray med. stiff Saturated, ML		20	15,18; 8,8; 7,8; 5,1; 9,10				
25.0-30.5' Sandy Silt, gray, very stiff Saturated, ML		25	10,10; 10,10; 16,16; 21,27; 100,5				
Boring terminated at 30.5'		30					

BORING LOG

PAGE 1 OF 1

PROJECT NUMBER: 98-478-0	PROJECT NAME: RMC - Beech Grove	
BORING / WELL NUMBER: MW-7	LOCATION: Beech Grove, Indiana	
DIAMETER: 4"	WATER DEPTH: 12.5'	DATE/TIME: 8/22/01
GEOLOGIST: Brendan O'Donnel	COMPLETION DEPTH: 25'	DATE STARTED: 8/22/01
DRILLING METHOD: HSA	SAMPLING METHOD: HSA/SS	DATE COMPLETED: 8/23/01
DRILLING SUBCONTRACTOR: Boart Longyear	DEVELOPMENT METHOD: Surged Block	YIELD: —

DESCRIPTION	WELL CONSTRUCTION	DEPTH (FT.)	PENETRATION BLOWS PER 6 IN.	RECOVERY (FT.)	INSTRUMENT READING	SAMPLE NUMBER	REMARKS
0.0'-5.0' Clay, gray to greenish gray moist to dry			— — 9,9 10,12 14,10	data not collected	NA		Well Construction Riser: Sch. 40 PVC 0'-15'
5.0-10.0' Clay, brown, dry to moist		5	10,11 7,11 12,13 8,11 12,11				Screen: 0.010 slot Sch. 40 PVC Sand Pack: #1 Sand 13'-25'
10.0'-15.0' Sandy Silt, trace gravel brown to dark brown, stiff moist to saturated, ML		10	5,6 4,12 7,14 22,47 14,14				Bentonite Seal: 11'-13' Grout: 0'-11'
15.0' 20.0 Sandy Silt, light brown and gray, saturated, very stiff, ML		15	28,34 8,13 24,37 14,15 18,32				Shelby tube collected at 26'-28' for sieve & Hydro testing
20.0'-25.0' Sandy Silt, light gray saturated, very stiff ML		20	15,10 21,28 16,21 21,24 15,16				
25.0'-28.0' Sandy Silt, light gray saturated, very stiff-Hard (ML)		25	19,25 4,14 38,68				
		30					

Boring terminated at 28'

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BORING LOG

PAGE 1 OF 1

PROJECT NUMBER: 98-478-05	PROJECT NAME: RAC - Beech Grove
BORING / WELL NUMBER: MW-8	LOCATION: Beech Grove, Indiana
DIAMETER: 4"	WATER DEPTH: 10.5' — DATE/TIME: 8/23/01
GEOLOGIST: Brendan O'Donnell	COMPLETION DEPTH: 30.0' — DATE STARTED: 8/21/01
DRILLING METHOD: HSA	SAMPLING METHOD: HSA/SS — DATE COMPLETED: 8/21/01
DRILLING SUBCONTRACTOR: Boart Longyear	DEVELOPMENT METHOD: Surged Block — YIELD: —

DESCRIPTION	WELL CONSTRUCTION	DEPTH (FT.)	PENETRATION BLOWS PER 6 IN.	RECOVERY (FT.)	INSTRUMENT READING	SAMPLE NUMBER	REMARKS
0.0'-5.0' Clay with construction debris (Fill) brown to dark brown, moist, FL			—; —; 14,6; 11,11	data not recorded	NA		Well Construction Riser: Sch. 40 PVC 0'-20' Screen: 0.010 slot Sch 40 PVC 20'-30' Sand Pack: #1 Sand 0'-18' Bentonite Seal: 16'-18' Grout: 0'-16' 95%/5% Type II Portland Cement/Bentonite
5.0'-10.0' Same as above, FL		5	—; 5,6; 10,6; 3,3; 3,4				
10.0'-15.0' Sandy Silt, gray, medium stiff, moist, ML		10	3,4; 5,4; 5,7; 7,11; 12,13				
15.0'-20.0' Sandy Silt, gray, M. stiff Saturated, ML		15	5,6; 8,9; 6,8; 9,18; 6,7				
20.0'-25.0' Sandy Silt, gray, M. stiff Saturated, ML		20	9,13; 6,7; 7,8; 7,11; 10,15				
25.0'-30.0' Sandy Silt, gray, stiff Saturated, ML		25	13,13; 16,4; 6,7; 13,23; 9,24				
		30	31,35				

Boring terminated at 30'

BORING LOG

PROJECT NUMBER: 98-478-05	PROJECT NAME: RMC Beech Grove	
BORING / WELL NUMBER: MW-9	LOCATION: Beech Grove, Indiana	
DIAMETER: 4"	WATER DEPTH: 15.3'	DATE/TIME: 8/23/01
GEOLOGIST: Brendan O'Donnell	COMPLETION DEPTH: 25'	DATE STARTED: 8/22/01
DRILLING METHOD: HSA	SAMPLING METHOD: HSA/SS	DATE COMPLETED: 8/23/01
DRILLING SUBCONTRACTOR: Boart Longyear	DEVELOPMENT METHOD: Surge & Bail	YIELD: —

DESCRIPTION	WELL CONSTRUCTION	DEPTH (FT.)	PENETRATION BLOWS PER 6 IN.	RECOVERY (FT.)	INSTRUMENT READING	SAMPLE NUMBER	REMARKS
0.5'-5.0' Sand with construction debris, dry, FL			15,12 10,10 7,7 7,7	data not recorded	N/A		Well Construction Riser: Sch. 40 PVC 0'-15'
5.0'-10.0' same as above, FL		5	8,8 10,10 4,5 5,11 5,7				Screen: 0.010 slot Sch. 40 PVC 15'-25' Sand Pack: #1 Sand 13'-15'
10.0'-15.0' sandy Silt, light gray, medium stiff, ML		10	6,8 5,5 5,8 7,8 4,11				Bentonite Seal: 11'-13'
15.0'-20.0' Sand Silt, light gray stiff, ML		15	6,6 7,7 3,4 4,11 11,13				grout: 0'-11'
20.0'-26.0' sandy Silt, light gray Hard, saturated (ML)		20	13,27 41,47 54,63 22,29 33,41				Shelby tube collected at 22'-24' and 24'-26' for sieve and hydro testing
		25	12,12				

Boring terminated at 26'

BORING LOG

PROJECT NUMBER: 98-478-03	PROJECT NAME: RML-Beech Grove
BORING / WELL NUMBER: MW-10	LOCATION: Beech Grove Indiana
DIAMETER: No well installed	WATER DEPTH: none encountered
	DATE/TIME:
GEOLOGIST: Eric Stenke	COMPLETION DEPTH: 129.5'
	DATE STARTED: 8/23/99
DRILLING METHOD: HSA and Roto-Sonic	SAMPLING METHOD: HSA/SS & Roto-Sonic
	DATE COMPLETED: 8/31/99
DRILLING SUBCONTRACTOR: Boart Longyear	DEVELOPMENT METHOD: Not Applicable
	YIELD: Not Applicable

DESCRIPTION	WELL CONSTRUCTION	DEPTH (FT.)	PENETRATION BLOWS PER 6 IN.	RECOVERY (FT.)	INSTRUMENT READING	SAMPLE NUMBER	REMARKS
0.0-3.0' CLAY, brown with construction debris - dry (Fill)(Loose) (3.0')			Data not collected	Data not collected	Not applicable	Not applicable	On 8/23/99 use Roto-Sonic rig to determine what depth to overdrill to with 10" Augers and set 9" surface casing. Set 8" surface casing to 29.5' and grout. Casing in on 8/25/99.
3.0'-9.0' CLAY, brown - moist (Loose) (9.0')		5					
9.0'-15.0' Clayey SILT, brown to dark brown - moist (Loose) (15.0')		10					
15.0'-20.0' Fine sandy CLAY, Light brown and gray with a trace of gravel - moist (Loose) (20.0')		15					
20.0'-23.0' SILT, dark and orange brown with a trace of subrounded to subangular gravel - moist (Loose) (23.0')		20					
23.0'-26.0' Fine sandy SILT, Light to dark gray with a trace of subangular to subrounded gravel - dry (medium dense) (26.0')		25					
26.0'-28.0' Fine SAND, gray with a trace of silt and subangular to subrounded gravel - dry (medium to very dense) (28.0')							
28.0'-32.0' SILT, dark gray with a trace of subangular to subrounded gravel - dry (medium to very dense) (32.0')		30					Surface Casing Set to 29.5. Begin 8" Roto-Sonic drilling and 6" continuous sampling From 29.5 to 77.0' on 8/30/99.

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BORING LOG

MW-10

DESCRIPTION	WELL CONSTRUCTION	DEPTH (FT.)	PENETRATION BLOWS PER 6 IN.	RECOVERY (FT.)	INSTRUMENT READING	SAMPLE NUMBER	REMARKS
32.0'-37.0' silty CLAY dark gray with some subangular to subrounded gravel - dry (medium dense) (37.0')		35					
37.0'-40.0' Fine SAND, gray with a trace of silt and gravel - dry (medium dense) (40.0')							
40.0'-48.0' SILT, dark gray with a trace of gravel - dry (very dense) (48.0')		40, 45					
48.0'-60.0' CLAY, dark gray and dark brown with a trace of coarse sand - moist (medium to very dense) (60.0')		50, 55, 60					
60.0'-62.0' Fine SAND, gray with a trace of silt - moist (Loose) (62.0')							
62.0'-66.0' SILT, dark gray with <1" fine sand lenses - moist (very dense) (66.0')		65					
66.0'-68.0' Fine SAND, dark gray with a trace of silt and gravel - moist (Loose) (68.0')							
68.0'-70.0' SILT, dark gray with some subrounded to subangular gravel - dry (medium to very dense) (70.0')		70					

BORING LOG

MW-10

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DESCRIPTION	WELL CONSTRUCTION	DEPTH (FT.)	PENETRATION BLOWS PER 6 IN.	RECOVERY (FT.)	INSTRUMENT READING	SAMPLE NUMBER	REMARKS
70.0'-77.0' SILT, dark gray with a trace of subrounded to subangular gravel - moist (medium to very dense (77.0')		75					
77.0'- 93.0' SILT, dark gray with a trace of gravel and intermittent clay and fine sand lenses - moist (medium to very dense) (93.0')		80 85 90					Continuous Roto-Sc sampling and drillin from 77.0' to 129.5' on 8/31/99.
93.0'- 98.0' silty CLAY, dark gray with a trace of subrounded to subangular gravel - dry (very dense) (98.0')		95					
98.0'-102.0' CLAY, glauconitic with brown sandy clay lenses - moist (Loose) (102.0')		100					
102.0'-110.0' CLAY, Light brown with a trace of silt and gravel - dry (medium to very dense)		105					

BORING LOG

MW-10

DESCRIPTION	WELL CONSTRUCTION	DEPTH (FT.)	PENETRATION BLOWS PER 6 IN.	RECOVERY (FT.)	INSTRUMENT READING	SAMPLE NUMBER	REMARKS
(110.0')							
110.0 120.0' SILT, gray to dark gray with a trace of gravel - dry (very dense)		110					
		115					
(120.0')							
120.0'-123.0' CLAY, dark gray with a trace of fine sand and gravel - dry (medium dense) (123.0')		120					
123.0'-129.5' Fine to coarse sandy CLAY, dark gray with a trace of gravel - moist (medium dense) (129.5')		125					
Boring terminated at 129.5'.		130					Per work plan cease Roto-Sonic sampling and drilling at 130.0 on 8/21/99 at 1540 hrs. Recovered sample to 129. Boring is dry. Boring sealed/filled to surface with a 95% cement/5% bentonite grout on 8/31/99.

8" borehole with 95/5% grout

BORING LOG

PROJECT NUMBER: 98-478-03	PROJECT NAME: RML - Beech Grove
BORING / WELL NUMBER: MW-20	LOCATION: Beech Grove Indiana
DIAMETER: 4"	WATER DEPTH: 1st Water @ 21.75'
DATE/TIME: 8/12 @ 0920	
GEOLOGIST: Eric Stanke	COMPLETION DEPTH: Well E.O.D. / Boring 110.0'
DATE STARTED: 8/12/99	
DRILLING METHOD: HSA and Roto-Sonic	SAMPLING METHOD: HSA/SS & Roto-Sonic
DATE COMPLETED: 8/21/99	
DRILLING SUBCONTRACTOR: Boart Longyear	DEVELOPMENT METHOD: Surge / bail / pump
YIELD: ~ 3 gpm	

DESCRIPTION	WELL CONSTRUCTION	DEPTH (FT.)	PENETRATION BLOWS PER 6 IN.	RECOVERY (FT.)	INSTRUMENT READING	SAMPLE NUMBER	REMARKS
0.0-1.5' Asphalt (~6") stone and rubble (1.5')			Data not collected.	Data not collected.	Not applicable.	Not applicable.	On 8/12/99 use 6¼" HSA and split spoon sampling to determine what depth to overdrill with 10" augers and set 8" surface casing. Set 8" surface to 31.0' on 8/12/99. Grout casing in on 8/12/99.
1.5'-4.0' CLAY, grey with a trace of organics and gravel - moist (Loose) (4.0')							
4.0'-7.0' CLAY, black, grey and brown with some silt - moist (Loose to medium dense) (7.0')		5					
7.0'-7.25' GRAVEL, Limestone with some silt (Loose) (7.25')							
7.25'-12.0' CLAY, Light brown and grey mottled with a trace of silt - moist (medium dense) (12.0')		10					
12.0'-15.5' CLAY, Light brown with some silt and a trace of fine sand and subangular to subrounded gravel - moist (medium dense) (15.5')							
15.5'-16.0' LIMESTONE Cobble (16.0')		15					
16.0'-21.75' SILT, tan with some fine sand and a trace of coarse sand - moist (Loose) (21.75')		20					
21.75'-22.0' Fine SAND, brown - wet (Loose) (22.0')							
22.0'-25.0' Grades from material at 21.75' to very fine SAND with silt - moist (Loose) (25.0')							
25.0'-26.25' SILT, dark brown with a trace of clay and subangular to subrounded gravel - moist (medium dense) (26.25')		25					
26.25'-27.0' Fine SAND, Light brown with some silt and a trace of gravel - wet (Loose) (27.0')							
27.0'-31.0' SILT, dark brown with a trace of clay and gravel - dry (very dense) (31.0')		30					Surface casing set to 31.0'. Begin 8" Roto-Sonic drilling and 6" Roto-Sonic continuous
31.0'-49.0' SILT, dark brown and dark grey with a trace of subangular to subrounded gravel -							

BORING LOG

MW-2A

DESCRIPTION	WELL CONSTRUCTION	DEPTH (FT.)	PENETRATION BLOWS PER 6 IN.	RECOVERY (FT.)	INSTRUMENT READING	SAMPLE NUMBER	REMARKS
dry (medium to very dense) (49.0')		35, 40, 45					Sampling from 31.0', 110.0' on 8/21/89.
49.0'-50.0' Fine sandy CLAY, dark gray and black with a trace of gravel - moist (medium dense) (50.0')		50					
50.0'-56.0' CLAY, dark gray with a trace of fine sand - moist (medium dense) (56.0')		55					
56.0'-58.0' CLAY, glauconitic with a trace of gray fine sand and silt - moist (medium dense) (58.0')							
58.0'-60.0' SILT, gray and tan mottled with some clay and a trace of fine sand and gravel - moist (medium to very dense) (60.0')		60					
60.0'-68.0' Fine sandy SILT with a trace of gravel - moist (loose to medium dense) (68.0')		65					
68.0'-80.0' Coarse SAND, black and gray with gravel and intermittent very fine sand lenses - wet (very loose)		70					

BORING LOG

MW-20

DESCRIPTION	WELL CONSTRUCTION	DEPTH (FT.)	PENETRATION BLOWS PER 6 IN.	RECOVERY (FT.)	INSTRUMENT READING	SAMPLE NUMBER	REMARKS
		75					
(80.0')		80					
80.0'-84.0' silty medium SAND, gray with a trace of gravel - moist (Loose) (84.0')							
84.0'-90.5' very fine SAND, gray - moist (loose) (90.5')		85					
90.5'-96.0' SILT, dark gray with a trace of gravel - dry (medium to very dense) (96.0')		90					
96.0'-99.0' silty CLAY, brown and gray mottled - dry (medium dense) (99.0')		95					
99.0'-110.0' SILT, dark gray with a trace of gravel - dry (very dense)		100					
		105					

BORING LOG

MW-20

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DESCRIPTION	WELL CONSTRUCTION	DEPTH (FT.)	PENETRATION BLOWS PER 6 IN.	RECOVERY (FT.)	INSTRUMENT READING	SAMPLE NUMBER	REMARKS
(110.0')		110					
Boring terminated at 110.0'.							Per conversation w Project Geologist ce Roto-Sonic sampling drilling at 110.0' on 8/21/99. Build bac boring to 80.0' a begin well construc at 80.0'.

8" borehole 15/5% grou and 4" diame PVC casing

8" borehole bentonite a 4" diameter PVC casing

8" borehole #5 sand and diameter PVC casing

8" borehole #5 sand and [illegible] slot 4" diam PVC Screen

8" boreho with bent

8" boreho with #5 sand

BORING LOG

PAGE 1 OF 4

PROJECT NUMBER: 98-478-03	PROJECT NAME: RMC - Beech Grove
BORING / WELL NUMBER: MW-30	LOCATION: Beech Grove Indiana
DIAMETER: No well installed.	WATER DEPTH: 1st water @ 13.75' / DATE/TIME: 8/11 @ 1000
GEOLOGIST: Eric Stanke	COMPLETION DEPTH: 130' / DATE STARTED: 8/11/99
DRILLING METHOD: HSA and Roto-Sonic	SAMPLING METHOD: HSA/SS & Roto-Sonic / DATE COMPLETED: 8/20/99
DRILLING SUBCONTRACTOR: Boart Longyear	DEVELOPMENT METHOD: Not Applicable / YIELD: Not Applicable

DESCRIPTION	WELL CONSTRUCTION	DEPTH (FT.)	PENETRATION BLOWS PER 6 IN.	RECOVERY (FT.)	INSTRUMENT READING	SAMPLE NUMBER	REMARKS
0.0-1.0' SILT, tan with trace organics-dry (1.0')			Data not collected.	Data not collected.	Not applicable.	Not applicable.	On 8/11/99 use 6¼ HSA and split spoon sampling to determine what depth to overdrill with 10" augers and set 8" surface casing. Set 8" surface casing to 32' on 8/11/99. Grout casing in on 8/12/99.
1.0'-2.0' SILT, gray and brown mottled with trace rock fragments - dry (2.0')							
2.0'-6.0' SILT, brown and tan mottled with trace of subrounded to rounded gravel - dry (6.0')		5					
6.0'-8.5' Fine sandy CLAY, Light brown and Tan with a trace of subrounded gravel - dry (8.5')							
8.5'-10.25' silty Fine SAND, with trace of subrounded to rounded gravel - moist (10.25')		10					
10.25'-13.0' CLAY, brown with trace of fine to course sand - moist (13.0')							
13.0'-13.75' SILT, gray - dry (13.75')							
13.75'-14.0' SAND, gray medium to coarse with trace clay - wet (14.0')		15					
14.0'-19.5' CLAY, gray with some subangular to rounded gravel - moist and medium dense (19.5')							
19.5'-20.0' silty fine SAND, with trace of subrounded to rounded gravel - moist (20.0')		20					
20.0'-21.5' subangular to rounded gravelly SILT, gray and wet (21.5')							
21.5'-24.5' SILT, gray with some subrounded to rounded gravel - moist (24.5')							
24.5'-25.0' Fine to coarse SAND - dry (25.0')		25					
25.0'-26.0' SILT, gray - dry (26.0')							
26.0'-26.5' clayey Fine SAND, [illegible] (26.5')							
26.5'-28.5' clayey SILT, gray with trace of rounded to subrounded gravel - dry (medium dense) (28.5')							
28.5'-29.0' CLAY, brown with trace of Fine sand (medium to very dense) - moist (29.0')							
29.0'-32.0' CLAY, gray with trace gravel and silt - dry (very dense) (32.0')		30					Surface casing set to 32.0'
32.0'-35.0' clayey SILT, gray with trace of							from 8" roto-sonic [illegible]

J:\FORMS\BOR-LOG

BORING LOG

MW-30

DESCRIPTION	WELL CONSTRUCTION	DEPTH (FT.)	PENETRATION BLOWS PER 6 IN.	RECOVERY (FT.)	INSTRUMENT READING	SAMPLE NUMBER	REMARKS
Subrounded gravel - dry (very dense) (35.0')		35					drilling and 6" Roto-Sonic Continuous sampling From 32.0' to 55.0' on 8/18/99.
35.0'-37.0' SILT, gray with trace clay and Subangular to subrounded gravel to 1" in diameter - moist (Loose) (37.0')							
37.0'-42.0' SILT, gray with some subrounded to rounded gravel - dry (medium to very dense) (42.0)		40					
42.0'-45.0' SILT, gray - dry (very dense) (45.0')		45					
45.0'-48.0' medium SAND, gray and black - wet grades to medium to coarse SAND, gray and black with some gravel - wet (very Loose) (48.0')							
48.0'-52.0' SILT, gray to black - dry (very dense) (52.0')		50					
52.0'-54.5' glauconitic CLAY, mixed with Fine sand and gravel - dry (medium to very dense) (54.5')							
54.5'-59.0' CLAY, Light brown with some Fine Sand and a trace of gravel - moist (Loose to medium dense) (59.0')		55					Continuous Roto-Sonic sampling and drilling from 55.0' to 117.0 on 8/19/99
59.0'-60.0' SILT, gray interbedded with Light brown Sand (medium dense) (60.0')		60					
60.0'-64.0' SAND, Light brown with a trace of silt and gravel - dry (medium dense) (64.0')							
64.0'-66.0' SILT, dark gray to gray with a trace clay and gravel - dry (medium dense) (66.0')		65					
66.0'-69.0' CLAY and fine SAND, Light brown and gray - dry (medium dense) (69.0')							
69.0'-70.0' coarse SAND, gray and black with some gravel and a trace of silt (Loose) (70.0')		70					

BORING LOG

MW-30

PAGE 3 OF

DESCRIPTION	WELL CONSTRUCTION	DEPTH (FT.)	PENETRATION BLOWS PER 6 IN.	RECOVERY (FT.)	INSTRUMENT READING	SAMPLE NUMBER	REMARKS
70.0'-79.0' SILT, gray with a trace of gravel - dry (medium to very dense (79.0')		75					
79.0'-80.0' SILT, gray with some gravel - wet (loose) (80.0')							
80.0'-81.0' gravelly SILT, gray to dark gray - wet (Loose) (81.0')		80					
81.0'-85.0' SILT interbedded with SAND, both gray. Silt has some clay - dry (medium dense). Sand is medium to coarse with a trace of gravel (medium dense). (85.0')							
85.0'-90.0' SILT, gray with a trace of subangular to subrounded gravel - dry (medium dense (90.0')		85					
90.0'-90.5' Fine to course SAND, gray - wet (Loose) (90.5')		90					
90.5'-98.0' silty CLAY, gray with a trace of subangular to subrounded gravel - dry (medium to very dense) (98.0')		95					
98.0'-105.0' CLAY, Light brown and Light gray mottled with a trace of silt and gravel - dry (medium to very dense) (105.0')		100					
105.0'-114.5' Clayey SILT, Light brown with a trace of gravel - dry (medium dense)		105					

BORING LOG

MW-30

DESCRIPTION	WELL CONSTRUCTION	DEPTH (FT.)	PENETRATION BLOWS PER 6 IN.	RECOVERY (FT.)	INSTRUMENT READING	SAMPLE NUMBER	REMARKS
(114.5')		110					
114.5'-127.0' Fine sandy SILT, grey-dry (very dense) (tree branch at 115.0')		115 120 125					Continuous Roto-Sonic sampling and drilling from 117.0' to 130.0' on 8/20/99.
(127.0')							
127.0'-130.0' very fine SAND, grey-moist (medium to very dense)							
(130.0')		130					
Boring terminated at 130.0' per work plan.							Per work plan cease Roto-Sonic sampling and drilling at 130.0' on 8/20/99 at 0910hrs. Boring is dry. Boring Sealed/Filled to surf with a 95% cement-5% bentonite grout on 8/20/99.
							8" borehole 95/5% grout

BORING LOG

PROJECT NUMBER: 98-478-03	PROJECT NAME: RML - Beech Grove	
BORING / WELL NUMBER: MW-6D	LOCATION: Beech Grove Indiana	
DIAMETER: 4"	WATER DEPTH: 26.0'	DATE/TIME: 8/17/99 @ 1100
GEOLOGIST: Eric Stanke	COMPLETION DEPTH: 123.0'	DATE STARTED: 8/12/99
DRILLING METHOD: HSA and Roto-Sonic	SAMPLING METHOD: HSA/SS & Roto-Sonic	DATE COMPLETED: 8/18/99
DRILLING SUBCONTRACTOR: Boart Longyear	DEVELOPMENT METHOD: Surge block & pump	YIELD: ~ 2 gpm

DESCRIPTION	WELL CONSTRUCTION	DEPTH (FT.)	PENETRATION BLOWS PER 6 IN.	RECOVERY (FT.)	INSTRUMENT READING	SAMPLE NUMBER	REMARKS
0.0'-10.0' See MW-6s Log. (10.0')		5					On 8/12/99 use data from MW-6s to auger without sampling to 10.0'. HSA/SS from 10.0' to 19.0'. On 8/14/99 over drill hole with 10" augers and set 8" casing to 19.0'.
10.0'-14.0' CLAY, dark brown and tan mottled with some subrounded gravel and a trace of fine sand - moist (loose) (14.0')		10					
14.0'-16.0' silty CLAY, dark brown and brown mottled with some subrounded gravel - moist (medium dense) (16.0')		15					
16.0'-19.0' SILT, dark gray with a trace of subrounded gravel - moist (medium dense) (19.0')							Surface casing set to 19.0'. Begin 8" Roto-Sonic drilling and 6" Roto-Sonic continuous sampling from 19.0' to 105.0' on 8/17/99.
19.0'-24.0' Fine SAND, gray with a trace of silt and angular gravel and intermittent < ½" thick clay lenses - moist (loose) (24.0')		20					
24.0'-26.0' silty CLAY, brown and gray mottled with a trace of fine sand and subangular to subrounded gravel - moist (medium dense) (26.0')		25					
26.0'-28.0' Fine to coarse SAND, brown with a trace of silt & some gravel - moist (medium dense) (28.0')							
28.0'-28.5' silty CLAY, gray with a trace of fine sand and subrounded gravel - dry (medium dense) (28.5')							
28.5'-29.0' Fine to coarse SAND - moist (loose) (29.0')							
29.0'-30.0' silty CLAY, gray with a trace of fine sand - dry (medium dense) (30.0')		30					
30.0'-44.0' CLAY, gray with some subangular to subrounded gravel - dry (medium to very dense)							

BORING LOG

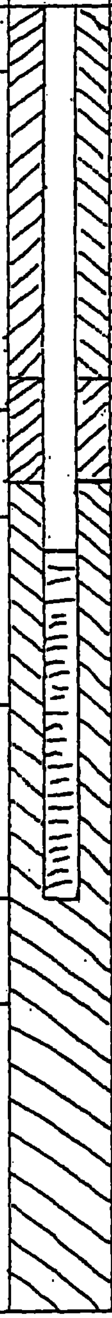
mw-6D

DESCRIPTION	WELL CONSTRUCTION	DEPTH (FT.)	PENETRATION BLOWS PER 6 IN.	RECOVERY (FT.)	INSTRUMENT READING	SAMPLE NUMBER	REMARKS
		35					
		40					
(44.0')							
44.0'-46.0' clayey GRAVEL, grey subangular to rounded -wet (loose) (46.0')		45					
46.0'-47.0' CLAY, grey with some subangular to subrounded gravel -dry (medium to very dense) (47.0')							
47.0'-50.0' fine SAND to Gravel, poorly sorted grey -wet (very loose) (50.0')							
50.0'-58.0' CLAY, glauconitic with a trace of rounded gravel-dry (very dense)		50					
		55					
(58.0')							
58.0'-60.0' Fine SAND, brown with some silt and a trace of gravel grades to Fine SAND, brown with a trace of silt and gravel -wet (Loose) (60.0')		60					
60.0'-62.0' Fine sandy SILT, Light brown with a trace of subangular to subrounded gravel -dry (medium dense) (62.0')							
62.0'-72.0' SILT, Light brown with a trace of clay, subrounded gravel and fine sand -dry (medium dense)		65					
		70					

BORING LOG

MW-60

DESCRIPTION	WELL CONSTRUCTION	DEPTH (FT.)	PENETRATION BLOWS PER 6 IN.	RECOVERY (FT.)	INSTRUMENT READING	SAMPLE NUMBER	REMARKS
(72.0')							
72.0'-82.0' Fine SAND, Light brown to dark gray with a trace of silt and gravel - moist (Loose) (82.0')		75, 80					
82.0'-85.0' SILT, dark gray with some fine sand and gravel - moist (Loose) (85.0')							
85.0'-90.5' Fine SAND, dark brown to dark gray - moist (Loose) (90.5')		85, 90					
90.5'-96.0' Fine to course SAND, dark gray with some gravel and a trace of silt - moist (Loose) (96.0')		95					
96.0'-99.0' Fine SAND, gray to dark gray with a trace of silt and gravel - moist (Loose) (99.0')							
99.0'-108.0' CLAY, gray with some gravel and a trace of silt - dry (medium to very dense)		100, 105					Continuous Roto-soni sampling and drilling fr 105.0' to 123.0' on 8/18/9



BORING LOG

mw-60

DESCRIPTION	WELL CONSTRUCTION	DEPTH (FT.)	PENETRATION BLOWS PER 6 IN.	RECOVERY (FT.)	INSTRUMENT READING	SAMPLE NUMBER	REMARKS
(108.0') 108.0'-123.0' silty CLAY, dark grey to gray with a trace of gravel <3" diameter - dry (medium to very dense) (123.0')		110 115 120					
Boring terminated at 123.0'		125 130					Per conversatio with Project Geolo Cease Roto-Sonics and drilling at 123 on 8/18/99. Build 6 to 96.0' and begin we construction at 96.

8" borehole 95/5% grou and 4" diam PVC casing

8" borehole bentonite a 4" diameter PVC casing.

8" borehole #5 sand and diameter & casing.

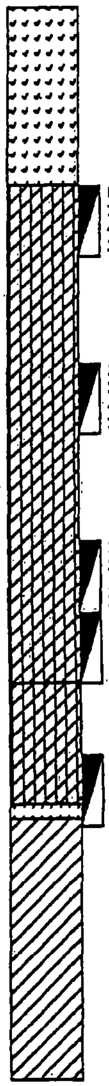
8" borehole #5 sand and slot 4" diam PVC screen

8" boreho with #5 Sand.

LOG OF TEST BORING
TEST BORING MW-11

DATE: 9/9/03
PROJECT: RMC Beech Grove
BORING LOCATION: Beech Grove, Indiana
DRILLING METHOD: 6-1/4" Hollow Stem Auger
DRILLING COMPANY: Boart Longyear
WATER ENCOUNTERED AT:

PROJECT NO.: 2003-1046
SURFACE ELEVATION:
CHECKED BY: PGS
DRILLER: Dan
INSPECTOR: S. Wiswall



ELEVATION / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS BLOWS PER 6 INCHES	Soil Description		SPT (N)	Moisture (%)	Other Tests
0		0-5' Topsoil, leaves.	0 0			
5	8/6 19/6 42/6 36/6	5-7' Very stiff to hard tan-brown silty clay with occasional fine gravel, dry.	5.0 -5	78		
10	10/6 12/6 48/6 15/6	10-12' Very stiff tan-brown silty caly with occasional fine gravel, subangular to rounded, moist.	10.0 -10	63		
15	10/6 24/6 10/6 17/6	15-17' Stiff brown silty clay, moist.	15 -15	27		
	12/6 17/6 34/6 25/6	16-16.5' Medium dense, fine to coarse sand, poorly sorted, subangular to rounded upwardly fining, saturated.	16.0 -16 17.0 -17	59		
20		19-20' Very stiff to hard gray to brown silty clay, medium dense, fine silty sand, rounded upwardly, fining, saturated.	19.0 -19			
	15/6 19/6 20/6 23/6	21-23' Very stiff brown silty clay with occasional fine gravel, dry.	21.0 -21	43		
		22.4-22.8' Medium dense gray fine to medium sand, well sorted, saturated.	22.4 -22.4			
25		22.8-23' Very stiff gray clay.	22.8 -22.8			
30		END OF BORING	30 -30			
35						

ADVANCED GEOSERVICES CORP.

LOG OF TEST BORING

TEST BORING MW-10

DATE: 9/9/03
PROJECT: RMC Beech Grove
BORING LOCATION: Beech Grove, Indiana
DRILLING METHOD: 6-1/4" Hollow Stem Auger
DRILLING COMPANY: Boart Longyear
WATER ENCOUNTERED AT:

PROJECT NO.: 2003-1046
SURFACE ELEVATION:
CHECKED BY: PGS
DRILLER: Dan
INSPECTOR: S. Wiswall

ELEVATION / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS BLOWS PER 6 INCHES	Soil Description	Depth / Elev.	SPT (N)	Moisture (%)	Other Tests
0		0-5' Topsoil, some root mat.	0 / 0			
5	5/6, 8/6, 12/6, 12/6	5-7' Stiff tan-brown to gray silty clay (CL) with frequent subangular to rounded fine gravel, dry to moist.	5.0 / -5	24		
10	7/6, 34/6, 45/6, 25/6	10-12' Medium stiff to stiff brown silty clay (CL), dry to moist.	10.0 / -10	70		
		12-15' Fine to coarse gravel with some clay, silt, poorly sorted subangular to rounded, saturated.	12.0 / -12			
15	15/6, 17/6, 43/6, 46/6	15-17' Very stiff brown silty clay, moist.	15.0 / -15	89		
	10/6, 20/6, 25/6, 26/6	17-19' Hard gray silty clay with frequent fine gravel, subangular to rounded.	17.0 / -17	51		
20	10/6, 23/6, 27/6, 30/6	19-21' Very stiff to hard gray silty clay with fine gravel, moist.	19.0 / -19	57		
25						
30						
35						
		END OF BORING	36.0 / -36			